SELECTED BIBLIOGRAPHY ON LOW-TEMPERATURE TAR

By H. H. Lowry and H. C. Anderson

* * * * * * * * * * **Information Circular 7882**

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SELECTED BIBLIOGRAPHY ON LOW-TEMPERATURE TAR[1/]

by

H. H. Lowry[2/] and H. C. Anderson[3/]

INTRODUCTION

Abstracts of papers on low-temperature tar published since 1942 are included in this selected bibliography. Abstract journals - including Chemical Abstracts, Fuel Abstracts, and B.C.U.R.A. Monthly - have been consulted through 1957. Abstracts of papers on low-temperature carbonization are not included unless information is given on composition, economics, processing, or utilization of the tar; thus, papers reporting only yields of tar from assay tests, pilot plants, and commercial operations are excluded.

Listing in the bibliography is alphabetical by authors; arrangement under each individual is chronological. Secondary authors are cross-indexed to the main entry. The subject index uses the main entries: Composition, economics, processing, and utilization with appropriate subheadings. A code letter following the abstract number indicates the country where the paper originated.

1/ Work on manuscript completed May 1958.
2/ Technologist (Coal), Division of Solid Fuels Technology, Central Experiment Station, Bureau of Mines, Pittsburgh, Pa.
3/ Technical editor, Division of Solid Fuels Technology, Central Experiment Station, Bureau of Mines, Pittsburgh, Pa.

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JOURNAL ABBREVIATIONS

Akad. Nauk Ukr. S.S.R., Inst. Teploenerget., Sbornik Trudov	Akademiya Nauk Ukrainskoĭ S.S.R., Institut Teploenergetiki, Sbornik Trudov (Academy of Sciences of the Ukrainian S.S.R., Institute of Thermal Power, Collected Works)
Anales soc. españ. fís. y quím.	Anales de la sociedad española de física y química
Angew. Chem.	Angewandte Chemie
Ann. mines Belg.	Annales des mines de Belgique
Avortef. diss. Kand. khim. Nauk Dnepropetrovsk. khim. tekhnol. Inst.	Thesis Dnepropetrovsk Chemical Technology Institute
B.C.U.R.A.	British Coal Utilization Research Association
Bd. Tr., German Div. (Doc. Unit)	Board of Trade, German Division (Document Unit)
Ber. deut. chem. Gesell.	Berichte der deutschen chemischen Gesellschaft
Bergbau u. Energiewirtsch.	Bergbau und Energiewirtschaft
Bergbautechnik	Bergbautechnik
Bib. Sci. Ind. Repts.	Bibliography of Scientific and Industrial Reports
BIOS Rept.	British Intelligence Objectives Subcommittee Reports
Braunkohle	Braunkohle
Brennstoff-Chem.	Brennstoff-Chemie
Brennstoff-u. Wärmewirt.	Brennstoff-und Wärmewirtschaft
Bull. Chem. Research Inst. Non-Aqueous Solns., Tohoku Univ.	Bulletin of the Chemical Research Institute of Non-Aqueous Solutions, Tohoku University
Bull. Inst. Phys. Chem. Research (Tokyo)	Bulletin of the Institute of Physical and Chemical Research (Tokyo)
Bull. Nagoya Inst. Technol.	Bulletin of Nagoya Institute of Technology
Bureau of Mines Inf. Circ.	Bureau of Mines Information Circular (United States)
Bureau of Mines Rept. of Investigations	Bureau of Mines Report of Investigations (United States)
Chem. Abs.	Chemical Abstracts
Chem. Age	Chemical Age (London)
Chem. and Ind.	Chemistry and Industry
Chem. Eng. and Min. Rev.	Chemical Engineering and Mining Review
Chem. Eng. News	Chemical and Engineering News
Chem. Eng. Progress	Chemical Engineering Progress
Chem. listy	Chemické listy
Chem. průmysl (Chem. Ind., Prague)	Chemický průmysl
Chem. Tech.	Chemical Technology
Chem. Tech., (Berlin)	Chemische Technik, (Berlin)
Chem. Trade Jour.	Chemical Trade Journal and Chemical Engineer
Chem. Zentr.	Chemisches Zentrablatt
CIOS Rept.	Combined Intelligence Objectives Subcommittee Reports

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Coal Tar (Kooru Taaru)	Coal Tar (Kooru Taaru) Journal of the Japan Tar Industry Association
Coal Utilization	Coal Utilization
Coke	Coke
Coke and Gas	Coke and Gas
Colliery Guard.	Colliery Guardian
Combustibles (Zaragoza)	Combustibles (Zaragoza)
Compt. rend. congr. ind. gaz. Paris (Assoc. tech. ind. gas France)	Compte rendu du congrès de l'industrie du gaz (Association technique de l'industrie du gaz en France). Paris, 1955
Doklady Akad. Nauk S.S.S.R.	Doklady Akademii Nauk S.S.S.R. (Proceedings of the Academy of Sciences of the U.S.S.R.)
Elec. Light and Power	Electric Light and Power
Erdöl u. Kohle	Erdöl und Kohle
Festschr. Paul Schläpfer	Festschrift Paul Schläpfer
FIAT Microfilm Reel	Field Information Agency Technical Microfilm Reel
Freiberg. Forsch.	Freiberger Forschungshefts
Fuel	Fuel in Science and Practice
Fuel Abs.	Fuel Abstracts
Gas-u. Wasserfach	Gas- und Wasserfach
General Headquarters, Supreme Commander for the Allied Powers (Tokyo), Natural Resources Sect., Rept.	General Headquarters, Supreme Commander for the Allied Powers (Tokyo), Natural Resources Section, Report
Glückauf	Glückauf
Ind. Eng. Chem.	Industrial and Engineering Chemistry
Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk	Izvestiya Akademii Nauk S.S.S.R., Otdelenie Tekhnicheskikh Nauk (Bulletin of the Academy of Sciences of the U.S.S.R.) (Technical Sciences Section)
Jour. Agr. Chem. Soc. Japan	Journal of the Agricultural Chemical Society of Japan
Jour. Am. Chem. Soc.	Journal, American Chemical Society
Jour. Appl. Chem. (U.S.S.R.)	Zhurnal Prikladnoĭ Khimii, U.S.S.R. (Journal of Applied Chemistry)
Jour. Chem. Soc.	Journal of the Chemical Society (London)
Jour. Chem. Soc. Japan	Journal of the Chemical Society of Japan
Jour. Fuel Soc. Japan	Journal of the Fuel Society of Japan
Jour. Inst. Fuel	Journal, Institute of Fuel
Jour. Madras Univ.	Journal of the Madras University
Jour. Sci. Ind. Research (India)	Journal of Scientific & Industrial Research (India)
Jour. Soc. Chem. Ind. (Japan)	Journal of the Society of Chemical Industry (Japan)
Khim. i Tekhnol. Topliva	Khimiya i Tekhnologiya Topliva (Chemistry and Technology of Fuels)
Khim. Referat. Zhur.	Khimicheskiĭ Referativnyĭ Zhurnal
Kōgaku Ihō (Shuho), Kyushu Univ.	Kyushu University Technology Report
Nauch. Tekh. Konferentsiya v Svyazi s Sorokaletmin Yubileem Uchebno-Nauch. Deyatel'nosti Tomsk Ind. Inst. Tezisy Dokladov	
Oel u. Kohle	Oel und Kohle

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Ohio State Univ. Studies Eng. Expt. Sta. Bull.	Ohio State University Studies. Engineering Experiment Station Bulletin
Paliva	Paliva
Petrol. Times	Petroleum Times
Petroleum (London)	Petroleum (London)
Prace Glównego Inst., Ser. B, Górnictwa, Komun.	Prace Glównego Instytutu Górnictwa, Komunikat
Proc. Am. Wood-Preservers' Assoc.	Proceedings of the American Wood-Preservers' Association
Przemysl Chem.	Przemysl Chemiczny (Chemical Industry)
Reichsamt Wirtschaftsausbau	Reichsamt Wirtschaftsausbau
Rev. inst. franç. pétrole et Ann. combustibles liquides	Revue de l'institut française du pétrole et Annales des combustibles liquides
Sborn. Trud. Inst. Teploenerg. Akad. Nauk Ukr. SSR	See: Akad. Nauk Ukr. S.S.R.
Sci. Repts. Tohôku Univ.	Science Reports of Tôhoku University
Smokeless Air	Smokeless Air
Stahl u. Eisen	Stahl und Eisen
Teer u. Bitumen	Teer und Bitumen
Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk	Trudy Instituta Goryuchikh Iskopaemykh, Akademiya Nauk S.S.S.R., Otdelenie Tekhnichesikh Nauk (Transactions of the Institute of Fuel Resources, Academy of Sciences of the U.S.S.R., Department of Technical Sciences.)
Trudy Vostoch.-Sibir. Filiala, Akad. Nauk S.S.S.R., Ser. Khim.	Trudy Vostochno-Sibirskogo Filiala, Akademiya Nauk S.S.S.R. (Transactions of the East-Siberian Branch of the Academy of Sciences of the U.S.S.R.) Seriya Khimicheskaya (Series on Chemistry)
Ukrain. Khem. Zhur. (Ukrain. Chem. Jour.)	Ukrains'kiĭ Khemichniĭ Zhurnal (Ukrainian Chemical Journal)
U.S. Dept. of Commerce, Off. Tech. Serv.	United States Department of Commerce, Official Technical Service
U. S. Naval Tech. Mission to Japan	United States Naval Technical Mission to Japan
Zhur. Priklad. Khim.	Zhurnal Prikladnoĭ Khimii. See Journal of Applied Chemistry U.S.S.R.

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ABSTRACTS

1. AGDE, G., AND KOHLES, E. [Identification of Phenols in Tar From the Low-Temperature Carbonization of Bituminous Coal.] Oel u. Kohle, vol. 40, 1944, pp. 1-7; Chem. Abs.,vol. 38, 1944, col. 105.

Tar obtained at 600° by low-temperature carbonization of Rhenish-Westphalian gas-flame coal by the Krupp-Lurgi heated-surface carbonization process was extracted with 3 percent NaOH solution saturated with NaCl; the phenols were separated by acidification and extraction with Et_2O; the average yield of several extractions was 14 percent by weight. The crude phenols were washed with water, distilled with xylene to remove traces of water and fractionated under vacuum with a Widmer column. The neutral oils boiling below 180° were removed by distillation, the higher boiling neutral oils were removed by steam distillation of a solution of the phenols in 10-percent NaOH solution and the highest boiling neutral material was extracted by C_6H_6 from the phenolate solution. The purified phenols were redistilled at atmospheric pressure and under vacuum. The following compounds were identified by suitable, known methods: PhOH, 3 cresols 1,4-dimethyl-2-hydroxybenzene, 1,3-dimethyl-4-hydroxybenzene, 1,3-dimethyl-5-hydroxybenzene, 1,2-dimethyl-4-hydroxybenzene, m-ethylphenol, 1,2-dimethyl-3-hydroxybenzene, isopseudocumenol, 3-methyl-5-ethylphenol, 4-hydroxyhydrindene, 1- and 2-naphthols. The phenylurethane, m. 162°-163°, of a phenol was isolated from the fraction boiling above 300° but could not be identified.

AL'TSHULER, V. S. See abs. 19.

2. ANDO, S., AND KOBAYASHI, T. [Preparation of Heavy Oil B From Low-Temperature Tar and Crude Petroleum.] Jour. Fuel Soc. Japan, vol. 29, 1950, pp. 34-42; Chem. Abs.,vol. 46, 1952, col. 3248.

In order to find the simplest process to produce heavy oil B from low-temperature tar with the least quantity of chemicals and solvent, (1) treatment with crude petroleum, (2) treatment with dilute H_2SO_4, and (3) simultaneous treatment with crude petroleum and dilute H_2SO_4 were studied. The results showed that most of asphaltene was precipitated by mixing low-temperature tar with some crude petroleum, alone or blended with a certain amount of dilute H_2SO_4, before distillation. The distillate became very stable and was found usable as heavy oil, B.

3. ANDO, S., AND YAMAMOTO, S. Corrosion Test by Low-Temperature Coal Tar. Coal Tar, vol. 4, 1952, pp. 208-210; Chem. Abs.,vol. 47, 1953, col. 6120.

Corrosive actions of various fractions of low-temperature coal tar against mild steel or Cr 13-steel were compared at their boiling states. Corrosions became severe when the boiling points exceeded 240°. The acidic fractions were more corrosive. In all instances, corrosion was excessive at the beginning of immersion testing and then gradually became mild; boiling accelerated the corrosion. Cr 13-steel was corrosion-resistant to low-temperature coal-tar fractions.

ASAOKA, N. See abs. 95.

AZUMA, H. See abs. 48.

4. BAECHLER, R. H. Toxicity of Various Fractions of Low-Temperature Coal-Tar Creosote. Proc. Am. Wood-Preservers' Assoc., vol. 49, 1953, pp. 12-17; Chem. Abs.,vol. 48, 1954, col. 4201.

Tar acids appearing throughout the boiling range of a low-temperature coal-tar creosote were very toxic to Madison 517 when tested by the agar-flask method. Upon aeration, they underwent only small loss in weight and no loss in toxicity. Most of the neutral oil fractions showed low toxicity. The distillation residue was found to be moderately toxic. A method for washing preservative oils before the toxicity test is described.

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5. BAKER, W., AND MILES, D. Red Color Given by Coal-Tar Phenols and Aqueous Alkalies Isolation of a Quinone Derived From a Tetrahydroxytetramethylbiphenyl. Jour. Chem. Soc., 1955, pp. 2089-2096; Chem. Abs.,vol. 50, 1956, col. 4087.

Coal tars, particularly those derived from the low-temperature, carbonization of coal, give red or red-brown colors with aqueous alkalies. It was earlier postulated that the red color was produced by the oxidative coupling in alkaline solution of a homocatechol and derivative of resorcinol. The present study was concerned with the products derived from the oxidative coupling of 2,3,5-$HO(Me_2)C_6H_2OH$ (I) and 3,2,6-$HO(Me_2)$-C_6H_2OH (II) in alkaline solution.

6. BARANSKI, K. [Chemical Products From Low-Temperature Brown Coal Tar.] Przemysl Chem., vol. 9, 1953, pp. 473-477, Chem. Abs.,vol. 51, 1957, col. 2255.

7. BASU, A. N., BHATNAGAR, J. N., AND ROY, A. K. [Indian Coal Tars.] Part I. Jour. Sci. Ind. Research (India), vol. 13A, 1954, pp. 127-131; Chem. Abs.,vol. 48, 1954, col. 9045.

The yield of tar from coal carbonized in India is about 10 gal. per ton of coal in gas works and 4 to 5 gal. per ton from coke ovens. The quantity of benzene, toluene, and xylene in Indian tars is negligible; the yields of light oil, middle oil, and tar acids are low. Naphthalene is present in moderate quantities.

Part II. Jour. Sci. Ind. Research (India), vol. 13A, 1954, pp. 217-220; B.C.U.R.A.,vol. 18, 1954, abs. 6798; Chem. Abs.,vol. 49, 1955, col. 593.

Laboratory experiments were carried out on these effects: (1) Rank and specific-gravity fractions on tar yield; (2) addition of water to the coal charge, or steam during carbonization, on yield of tar and tar acids; (3) the presence of a cracking agent (shale) with and without steam addition on the yield of tar and tar acids (the particular shale used without steam reduced the yield, and the restricted use of steam brought the yield to the former noncatalyzed level); and (4) catalytic effect of three different samples of shale, firebrick, quartz, coke and silica-alumina on the cracking of tar acids (the most active were two of the shales, a freshly-prepared coke, and the Al_2O_3-SiO_2 catalysts that gave conversion up to 98 percent). The products were mainly carbon, aromatic hydrocarbons of the naphthalene series and gases (CO and H_2).

The yield of tar becomes less as coal of lower specific gravity is used or when higher temperatures are used for carbonization. The mineral matter associated with Indian coals acts as a decomposition catalyst for tar acids, as shown by experiments on the decomposition of PhOH at temperatures above 800°.

8. BECKER, J. (Koppers Co.). Low-Temperature Tar Conversion to High-Temperature Tar in High-Temperature Coking Chambers. United States Patent 2,756,198, 1956; British Patent 766,095. Chem. Abs., vol. 50, 1956, col. 16082.

A process for using low-temperature tar comprising the steps of mixing the low-temperature tar with a coal destined for high-temperature coking at a temperature above 800° C. in high-temperature coking chambers and subjecting the mixture to high-temperature coking in high-temperature chamber ovens, and recovering the volatile part of the low-temperature tar in the form of high-temperature tar from the chamber ovens in mixture with the high-temperature tar given off at the same time therein from the coking of the coal therein, thereby increasing the high-temperature tar yield of the chambers without substantially increasing the coal coke yield of the chambers. Approximately 1 to 10 percent tar is used in the mixture.

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9. BEMMANN, -. Phenols From Hydrogenated Oils. U. S. Dept. Commerce, Off. Tech. Serv., PB L52,005, June 1940, pp. 83-90; Bib. Sci. Ind. Repts., vol. 7, 1947, p. 574.

Removal of phenols from low-temperature tars, and hydrogenated oils in the semisolid phase is discussed. Three methods of extraction are described: Hot-water method, sodium sulfide process and sodium hydroxide-countercurrent process.

10. BERKOWITZ, N., AND DAMMEYER, W. Pyrolysis of Coal in the Presence of Nitric Oxide. Fuel, vol. 35, 1956, pp. 19-30; Chem. Abs., vol. 50, 1956, col. 3733.

Examination of tars obtained by low-temperature carbonization of a subbituminous coal in the presence of NO suggests that NO will both retard thermal decomposition and inhibit secondary polymerization in the tar phase. But both reactions are subject to the condition that NO is present at the start of incipient pyrolysis (they do not occur if NO is admitted to the retorts at a point above the decomposition temperature of the coal), and their extent depends sharply upon the concentration of NO. At comparatively low partial pressure of NO, the dominant reaction is retardation of decomposition; significant modification of the tar, leading to a greater proportion of low-boiling material, is confined to high-partial pressure of NO. Conclusions, after analyzing tar yields and infrared spectra of tar fractions, are that the inhibition of secondary polymerization in the tar phase involves the transient attachment of NO to primary tar molecules, and that the inhibitory effect of NO is essentially temporary. Tars modified by NO do not appear to be more stable than normal tars in the presence of light, and their composition, as determined by infrared spectroscopy, is not perceptibly different.

BHATNAGAR, J. N. See abs. 7.

11. BIRTHLER, R., AND SZKIBIK, C. [Experimental Results and Operational Experience With the Refining of Brown Coal Tar Products by Medium Pressure Hydrogenation.] Freiberg. Forsch. vol. A36, 1955, pp. 42-57; Chem. Abs., vol. 50, 1956, col. 4482; Fuel Abs., vol. 19, 1956, abs. 3175.

It has been demonstrated on an experimental scale that tar from low-temperature carbonization of brown coal can be refined at a pressure of 50 to 70 atmosphere (corresponding to a hydrogen partial pressure of 30 to 40 atmosphere) over a fixed molybdenum catalyst. If the brown coal tar is mixed with hydrogenated medium oils in certain proportions before medium-pressure refining, a degree of refining adequate for finished products can be achieved. Similar highly refined products are obtained if prerefined skimming residue fractions are again subjected to medium-pressure treatment with hydrogen-containing gases. Industrial medium-pressure refining of raw diesel oils obtained from brown-coal low-temperature tar has proved feasible. Despite the final runnings of the initial product possessing a high boiling point, periods of roughly 2,600 hours of operation without regeneration of the catalyst were achieved. Regeneration was carried out by heating with air in place.

BLONSKAYA, A. I. See abs. 74.

BOBROVA, A. A. See abs. 99100.

12. BRISTOW, W. A. Smokeless Fuel. Colliery Guard., vol. 165, Aug. 28, 1942, p. 264.

Petrol, diesel oil, fuel oils, creosote, bitumens, resins are among the products obtained from the crude oil, produced in the manufacture of "Coalite." The crude oil is rich in tar acids.

13. _____. Development of Liquid Products From Low-Temperature Carbonization. Jour. Inst. Fuel, vol. 20, 1947, pp. 109-130.

The low-temperature carbonization plants in Great Britain were designated originally to make a smokeless fuel suitable for all purposes, and especially

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for domestic use. This policy is unchanged. Bituminous coal with a volatile content of about 35 percent is distilled in stationary metal retorts, externally heated, for about 4 hours at about 600°. Each retort is water-sealed; the residual fuel is discharged into a hermetically sealed cooling chamber underneath each retort. The volatile products are drawn through water-cooled offtake pipes, pass to the hydraulic mains, and then through an electrostatic precipitator to the final condensers. The gas is scrubbed to remove light oil, and the stripped gas is used for heating the retorts. The quantity of liquid products is about 9 percent of the coal. The first plant for fractionating the liquid products used pot stills, but these caused a considerable amount of cracking, with an increase in amount of pitch and the loss of valuable constituents. A modern pipe still was then installed, based on petroleum practice, and this gave a very different quantity and quality of products. The crude oil is fractionated into light, middle, heavy oil, and pitch for which average yields are 2 percent, 38 to 40 percent, 30 to 32 percent, and 25 to 26 percent, respectively, and these are processed separately. The crude light oil stripped from the gas contains about 25 percent saturated hydrocarbons, 50 percent olefins and 25 percent aromatic compounds, and boils between 40° and 180°. Both the light and medium oils are treated with NaOH solution in a continuous washer to remove tar acids. The recovered tar acids have been distilled in pot stills, but a new continuous plant is being constructed with a capacity of 20,000 gallons of tar acids per week, with the crude once-run acids free from water and tar. Five columns will be used, the overhead being: Number 1 column: 80 percent phenol, recycled to 98 percent; Number 2, 80 percent O-cresol; Number 3, 49 to 51 percent m-cresol; Number 4, xylenols free from high-boiling tar acids; and Number 5, high-boiling acids free from xylenols. Flowsheets are given. Provision will be made for chlorination of tar acids, to produce material of high germicidal value. The ammonia liquor from low-temperature carbonization will be extracted with butyl acetate to remove monohydric and dihydric phenols present to the extent of 1 to 1.5 percent. Corrosion was found in the original mild-steel pipe still. As a result of tests, the tubes and headers in the radiant section of the still were made of stainless steel. The tubular heat exchangers and condensers have cast-iron bodies and tubes and tube plates of Iconel, and after 8 years are in good condition. Cast-iron tubes and return bends in the convection bank were satisfactory. Certain ordinary sections of the cast-iron fractionating column have been replaced with the more resistant Audcoloy; this material has been used for all of the bubble caps. The products are discussed in some detail. Production of phenols and cresols is still far below requirements of the plastics industry, and these are also in demand for pharmaceutical and other uses. The higher boiling tar acids go to the disinfectant industry and for manufacturing insecticides. Some of the tar acids are also used for flotation mediums. Diesel oil is sold for city-transport systems. Motor fuel is also produced, and a rubber solvent boiling 90° to 150°, also paint solvents, creosote reclamol (for rubber recovery), bituminous materials, and other products. Very extensive research has been carried out on the tar acids, and numerous products are in prospect. Numerous flowsheets and diagrams are presented. Comparison of this British work with German low-temperature distillation of lignite indicates that the varied use of the products has progressed to a very much greater extent in Great Britain.

14. BRITISH INTELLIGENCE OBJECTIVES SUBCOMMITTEE. Drying, Briqueting and Low-Temperature Carbonization of Brown Coal in Lurgi-Spulgas Retort. Final Rept. 626, Item 30, 1946, 16 pp.

Concise description of individual processes is given, with the aid of diagrams and flowsheets. Economic aspects are discussed.

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15. CAWLEY, C. M., AND KINGMAN, F. E. T. Hydrogenation of Bituminous Coal Tars. Fuel, vol. 22, 1943, pp. 156-164. Chem. Abs., vol. 38, 1944, col. 849.

The hydrogenation of tars from three sources was investigated in a two-stage liquid- and vapor-phase process as a part of the program of the Fuel Research Board. Previous work showed that a single-stage, fixed-catalyst process was not applicable to high-temperature tars because the catalyst deteriorated too rapidly. Hydrogenation of low-temperature tar (I), high-temperature vertical retort tar (II), and coke-oven tar (III) was studied. Two plants were used for the first-stage work, 1 with a 600-milliliter-converter capacity was used for I and II and 1 with 7-liter capacity for III. Pressure of 200 atmosphere and temperature of 450° were used in all tests. The second, vapor-phase stage was carried out in a 25-milliliter converter at 200-atmosphere pressure and variable temperatures with pelleted MoS_2 as catalyst. Products of the first stage were analyzed for tar acids, tar bases, asphaltic material, and the oils were fractionated. Ultimate analyses were made of the liquids and tars from the vapor stage, gases were analyzed, and motor spirit octane number and Diesel fuel cetene number were determined. Hydrogenation of I was studied for 22 catalysts, Mo compounds and HI being the best. A standard catalyst of 0.1 percent HI + 0.1 percent MoO_3 (added as $(NH_4)_2$-MoO_4 in solution) was adopted. Middle oil from the first hydrogenation was treated in the second stage for II and III at 415° for motor spirit and 380° for Diesel fuel. Middle oil from III was treated at 430° and 390°, respectively. No fundamental difference was found between the behavior of the three tars for possibility of complete conversion to middle oil and spirit. Reaction time for a given degree of conversion and also the H consumption increased in the order I, II, III, and was directly related to the H to C ratio of the tars. Final yields of middle oil and spirit were similar, and no tar appeared to contain an appreciable part of material not susceptible to treatment. Catalytic effects were not exactly the same, but the catalyst most suitable for I was suitable for II and III. Octane numbers were 66 to 70 and cetene numbers 43 to 46. Gaseous products caused a 25-percent weight loss, believed to be much greater than for full-scale plant operations.

16. CHARVAT, V. [Determination of Tar-Forming Substances in Coal.] Paliva (Czech.), vol. 34, No. 3, 1954, pp. 62-68; Fuel Abs., vol. 17, 1955, abs. 5132.

Thirty-three coals and lignites were carbonized at low temperatures under 1 to 2 millimeter Hg and at atmospheric pressure, and up to 1,000° C. under 1 to 2 millimeter Hg. The results show how distillation conditions affect the yields of semicoke, tar, water, and gas and the composition of the products (phenolic, neutral, and unsaturated compounds in the tar, and CH_4, C_2H_6, C_2H_4, H_2, CO and CO_2 in the gas). The use of a vacuum sharply increases the yield of primary tar and improves its quality. A separate series of experiments on the low-temperature carbonization of brown coals showed the effect on the tar yield of oxidizing the coals by drying in air at 80° C.

17. CHEMICAL AGE (London). New Rot-Proofing Compound: Valuable Byproduct in Manufacture of Smokeless Fuel. Vol. 71, 1954, pp. 723-724; Fuel Abs., vol. 17, 1955, abs. 1317.

Low-temperature tar from the Rexco process is the least cracked of tars in commercial production owing to the method of internal heating employed in the process. The dehydrated tar, known as "Rexcopine," has been tested and found to be superior to any coal- or wood-tar product previously used as a rot-proofing treatment for hemp, jute and other products. Some details of tests are presented. Considerable expansion of production of Rexco is now taking place.

18. CHEMICAL TRADE JOURNAL AND CHEMICAL ENGINEER. "Coalite" Chemicals. Vol. 127, July 7, 1950, p. 23; Fuel Abs., vol. 8, 1950, abs. 2657.

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Several new chemical products which it is anticipated will be on sale during the present financial year are listed in the annual report of Coalite Chemical Co. Some of these are raw materials for the preparation of pure dihydric phenols, and for manufacturing adhesives. Much attention is being given to the working up of tars from low temperature coal carbonization. One of the new products, 2-methyl resorcinol, has been used as starting material for a projected total synthesis of cortisone. Two new sections of the refinery, one for making plasticizers and the other for manufacturing chlorinated products came into operation last July, and other refining units are due to begin operation shortly. It is also planned to manufacture selective weedkillers of various types.

CHERNYKH, M. K. See abs. 101.

19. CHERNYSHEV, A. B., TOLUBINSKII, V. I., AL'TSHULER, V. S., RABINOVICH, M. I., SHAFIR, G. A., AND KHOPATA, G. N. [Laboratory Investigation of Semicoking of Nonagglomerated Ukrain. S.S.R. Brown Coal Under Pressure.] Akad. Nauk Ukr. S.S.R., Inst. Teploenerget., Sbornik Trudov, No. 11, 1955, pp. 37-50; Chem. Abs., vol. 50, 1956, col. 10380.

Experiments were carried out at 50 atmosphere in a stream of nitrogen and of a nitrogen-steam mixture. Initial decomposition in nitrogen at up to 600° C. is independent of pressure but the paraffin content increases and the content of light fractions decreases with increase of pressure. The experiments in the steam-nitrogen atmosphere showed that the introduction of steam increases the yield of gas and primary tar and decreases that of low temperature coke; at the same time increase of pressure causes an increase in the specific gravity of the tar, its content of paraffin wax and silica-gel tars, and a decrease in its content of bases, phenols, carboxylic acids, and the neutral hydrocarbon portion; the extent of dissociation of the steam introduced with the blast decreases with increase of pressure, for the same residence time of the vapor and gaseous products in the reaction apparatus.

20. CHLOSTA, J. [Wash-Oil Problem.] Oel u. Kohle, vol. 37, 1941, pp. 961-962; Chem. Abs.,vol. 37, 1943, col. 6110.

Meier-Grolman and others (Chem. Abs. 35, 8255) have deduced from experimental studies of the vapor pressure of solutions of benzene in paraffin oil and Solway oil-paraffin oil mixtures that the higher the proportion of aliphatic compounds in a wash oil the less suitable it is for benzene scrubbing. This generalization is not supported. Paraffin oils from brown-coal tar and low-viscous oils from the Fischer-Tropsch hydrocarbon synthesis process are both being successfully used for benzene scrubbing.

21. CHOROWER, C. [Pyrolysis at Low-Temperature of Mequinenza Coal.] Anales soc. españ. fís. y quím., vol. 36, 1940, pp. 165-226; Chem. Zentr. I, 1941, p. 3030; Chem. Abs.,vol. 37, 1942, col. 6434.

In the low-temperature distillation of Mequinenza coal 13 to 14.5 percent of tar was obtained in the carbonizing unit and 10.7 to 12.0 percent in the rotary drum with or without steam. The yield of semicoke was 65 to 70.5 percent; the gas production was 91 to 109 liter per kilogram. The tar was distilled with and without steam, the fractions were freed from phenol and paraffin and purified by treatment with H_2SO_4. The coal tested was in many respects more like mineral coal than soft coal (thus, the liquid tar was of higher specific gravity, was free from resins and lower in paraffin and higher in phenol than in the case of soft coal). The pitch content of the tar was very slight, the yield of viscous oils was high. By distillation with steam 32 percent of benzine was obtained. Of the high S content established in the coking 8.5 percent was present in the benzine, 6.3 percent in the motor oil

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and 5.6 percent in the lubricating oil from the tar.

CHUTO, M. See abs. 89.

CLARK, E. L. See abs. 168.

22. COKE. Light Oils From Low-Temperature Carbonization. Vol. 6, July 1944, p. 135; B.C.U.R.A., vol. 8, 1944, abs. 8785.

An account is given of comparative tests of light-oil yields carried out at the Edderitz plant of the Riebeck' sche Montanwerke, where three types of low-temperature-carbonization plant are in use - Borsig-Geissen retorts (external heating), Kosag-Geissen retorts (external heating), and a Freiberg Spulgas unit. Results of these tests, as well as analyses of the highly complex brown-coal light oils are tabulated. A modern light-oil recovery plant is described diagrammatically.

DAMMEYER, W. See abs. 10.

23. DAVIES, C. (Pittsburgh Coal Carbonization Co.), Manufacture of Low-Temperature Coal-Tar Derivative Insecticide, Fungicide, and the Like. United States Patent 2,269,366, Jan. 6, 1942. Chem. Abs., vol. 36, 1942, col. 2990.

Material from low-temperature carbonization of coal containing 25 percent of oil of boiling point <275° is treated with aqueous alkali hydroxide (NaOH) that has been saturated with the corresponding alkali chloride; the aqueous solution, separated from the tar, is claimed as an insecticide, fungicide, and other purposes. Alternatively, the chloride may be added after the treatment with alkali hydroxide, thereby precipitating the tar from the homogenous solution. Emulsifying agents or alkali should be added before dilution for use.

24. DEMANN, W. [Present Status of Low-Temperature Coking in Germany and Its Relation to the German Energy Situation.] Gas-u. Wasserfach, vol. 85, 1942, pp. 375-381; Chem. Abs., vol. 37, 1943, col. 4551.

A review of low-temperature coking processes with 52 references. Tar obtained by low-temperature coking of bituminous coal differs from that obtained from brown coal by its aromatic-naphthenic structure; gasoline obtained from this tar has an octane number of 80 to 90. Coke from low-temperature carbonization of bituminous coal of an ash content of 2 percent or less is used for metallurgical purposes, as in manufacturing ferrosilicon. In order to obtain tars suitable for motor fuels, several German gasworks have installed special coking apparatus in their gas generators. The Miller process which combines low-temperature coking with the Fischer-Tropsch hydrocarbon synthesis increases the oil yield of the synthetic process by 20 to 30 percent.

25. DEPP, E. A., AND NEUWORTH, M. B. Refining Low-Temperature Tar Acids With Ion-Exchange Resins. Ind. Eng. Chem., vol. 49, 1957, pp. 182-185; Chem. Abs., vol. 51, 1957, col. 13265.

For the first time, ion-exchange resins are used to reduce the equivalent butyric acid and the equivalent pyridine contents in the low-boiling-tar acids to 0.05 and 0.07 percent, respectively. The resins are the sulfonic acid and the quaternary ammonium hydroxide types. The operation is controlled by the effluent pH values, which are predetermined empirically as 6.3 for butyric acid and 4.5 for pyridine tolerable levels.

26. DIERICHS, A., AND HEINICHEN, G. [Determination of Phenol in Tar.] Freiberg. Forsch., vol. A36, 1955, pp. 82-94; Chem. Abs., vol. 50, 1956, col. 16077.

During low-temperature carbonization of lignite, the phenols and other oxygenated compounds appear both in the aqueous-process liquor and in the tar. Measurements of these oxygenated components resulting from low-temperature carbonization may serve as a parameter

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for the classification of lignites. However, such measurements are complicated by the instability of the tar and the complex nature of some of the acidic substances. Volumetric methods have been devised for exacting lignite tar with 10 to 15 percent caustic and measuring either decrease in tar volume or increase in extract volume. One source of error occurs because the caustic soluble fraction of the tar does not correspond exactly to the acidic constituents of lignite tars. Gravimetric methods have employed complete extraction of all acidic components of the tar followed by separation of neutral oils, acidification of the alkali extract, ether extraction of liberated phenols and fatty acids, and finally their gravimetric determination. The present method outlines separation of aqueous-process liquor from lignite tar in a Fischer retort, followed by determination of phenols and fatty acids in tar phase. A 50-gram lignite sample is first crushed below 1-millimeter size and dried to essentially constant weight at 30 to 35°. Apparatus for low-temperature carbonization consists of: (1) a Fischer-Schrader Al retort, (2) a constant-temperature jacketed tar receiver, (3) a water-collecting tube with cooling jacket, and (4) a $CaCl_2$-filled tube for escape of gases from the lignite carbonization. The jacketed tar receiver is washed with 300 milliliter xylol and treated with aqueous caustic washes. Neutral oils are separated from the aqueous alkali solution. It is then extracted with ether and finally acidified with HCl. Solids are filtered off, and phenols and fatty acids are separated by Na_2CO_3 solution.

EDELEAUNU, G.m.b.H. See abs. 30, 67.

27. EDEL'SHTEĬN, N. G., AND LANIN, V. A. [Chemical-Composition Studies of Low-Temperature-Carbonization Coal Tar.] Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, vol. 5, 1955, pp. 144-155; Chem. Abs.,vol. 50, 1956, col. 10379.

Pintsch-oven low-temperature tar was separated into its constituents by conventional methods, and the average of 2 results was neutral asphaltenes 12.56, basic asphaltenes 2.61, acid asphaltenes 18.82, phenols 13.23, bases 2.31, neutral oil 17.66, crystalline paraffins 7.34, silica-gel tars (I) (benzene extract) 15.40, I (acetone extract) 2.47, carbenes 0.45, and carbides and dust 1.44 percent. The low-temperature-tar asphaltenes and tars differ from shale-oil tars by being lower in C and higher in H, with a considerably higher C:H ratio. Their specific gravity is somewhat higher, and they are cyclic in structure. The asphaltenes and silica-gel tars of coal tar and shale oil were hydrogenated, molecular weights d_4^{20} and n_4^{20} of the separated compounds were determined, and empirical formulas of the hydrogenated compounds calculated. The neutral oil was separated into saturated, intermediate (iodine number 23), unsaturated (iodine number 51), a small quantity of a mixture of unsaturated and aromatic hydrocarbons, and 44.9 percent aromatic hydrocarbons. While naphthenes seem to be predominantly present in the neutral-oil fraction of shale oil, aromatic hydrocarbons are predominant in coal oil.

EDEMSKAYA, N. D. See abs. 108.

28. FADEICHEVA, A. G. [Separation and Investigation of the Composition of Phenols in Primary Tar From Ukrainian Bituminous Brown Coals.] Avtoref. Diss. Kand. Khim. Nauk, Dnepropetrovsk. Khim. Tekhnol. Inst. Title in Ref. Zh. Khim., Moscow, 1955, (23) 56279D; Fuel Abs.,vol. 19, 1956, abs. 4961.

Thesis, 1955.

FADEICHEVA, A. G. See abs. 75, 98, 101.

29. FIELD INFORMATION AGENCY TECHNICAL. I. G. Farbenindustrie Reports on Effect of Various Catalysts in Hydrogenation. Microfilm Reel LF 27 (T.O. M. 145), Frames 1-538; U. S. Dept. Commerce, Off. Tech. Serv., PBL81692, 1935-1944.

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Contains 73 reports on oil and coal hydrogenation and low-temperature carbonization, processing of tar and petroleum and properties of the products. Phenol recovery and the effect of various catalysts are discussed.

30. FISCHER, K. (EDELEANU, G.m.b.H.) [Removing Traces of Sulfur Dioxide From Distillation Tar or Its Products.] German Patent 737,535, 1943; Chem. Abs., vol. 39, 1945, col. 5473.

An extract of low-temperature carbonization tar is treated in a multistage evaporator, the last stage operating under vacuum. The SO_2 content of the tar is thereby reduced to 0.02 to 0.07 percent. Then the tar is heated at 180° to 190°.

FISCHER, K. See abs. 155.

FRESE, -. See abs. 51.

31. FUCHS, W., AND HAMACHER, K. A. Composition and Transformation of the Hydrocarbons of Low-Temperature Coal Tars. Erdöl u. Kohle, vol. 5, 1952, pp. 80-83; Chem. Abs.,vol. 46, 1952, col. 4768.

The composition of two low-temperature tar oils, a Saar neutral oil (150° to 320°; density = 0.9100; n_D^{25} = 1.5185; average molecular weight 160) and a Saar light oil, (32° to 280°; density = 0.8415; n_D^{25} = 1.4754; average molecular weight = 169) is determined by means of Kattwinkel's procedure (Chem. Abs. vol. 22, col. 3039) slightly modified. Composition of neutral oil in volume-percent: polynuclear aromatics 37, twice unsaturated naphthenes 50, saturated naphthenes and paraffins 9 and 4, respectively; of light oil in volume-percent: mononuclear aromatics 47, mono- and di-unsaturated naphthenes, saturated naphthenes and paraffins 8 and 8, respectively. The pyrolysis of coal is discussed briefly on the basis of molecule models (Fuchs and Sandhoff, Chem. Abs. vol. 36, col. 302). In connection with the transformation of hydrocarbons during the pyrolysis of coal, the formation of naphthalene is possible thermodynamically at temperatures below 300°.

32. _____. [Possibilities of Conversion and Use of Hydrocarbons in Low-Temperature Coal Tars.] Erdöl u. Kohle, vol. 5, 1952, pp. 561-563; Chem. Abs.,vol. 47, 1953, col. 294. A progress report.

In order to improve the economics of low-temperature carbonization, dehydrogenation of the light-oil fraction (80° to 145°) is proposed. Dehydrogenation experiments with S, catalysts (Ti, Mo-Al, active C, Cu-Cr-O, Ni-Al), and O (air) are described briefly. Composition of final product (also in terms of change in initial composition) in terms of aromatics, saturates, and unsaturates are tabulated. Products may be useful in the rubber and paint industries. Possibility of isolation of individual compositions by means of urea and solvent extraction (furfural) is mentioned.

FUCHS, W. See abs. 118.

FUJITA, H. See abs. 34.

33. FUNASAKA, W., YOKOGAWA, C., AND SUGA, S. [Extraction of Tar Acids With Methanol From Low-Temperature Tar.] Jour. Chem. Soc. Japan, Ind. Chem. Sec., vol. 51, 1948, pp. 27-28; Chem. Abs.,vol. 44, 1950, col. 9138.

From 20 grams crude middle oil, boiling at 200° to 250°, acid content 40 percent, tar acids were extracted at 20° to 30° with MeOH for comparison with EtOH, NMe_3, and ethylene glycol. When 80 percent MeOH is used, the oil extracted amounts to 61 percent, including 9 percent acids, if the ratio of crude oil and solvent is kept at 1:2. EtOH is inferior to MeOH. The properties of the crude oil and the purified oil extracted with 80 percent MeOH are, respectively, d_{20}^{20}, 0.981, 0.906; n_D^{20} 1.550, 1.515; acid oils 40, 3 percent; and neutral and basic oils 60, 97 percent.

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34. FUNASAKA, W., YOKOGAWA, C., HAYASHI, K., KAWAMURA, T., FUJITA, H., AND SUGA, S. [Durability and Regeneration of Catalyzers of the Iron Family in Hydrogenation of Low-Temperature Tar.] Jour. Chem. Soc. Japan, Chem. Sec., vol. 52, 1949, pp. 148-149; Chem. Abs.,vol. 45, 1951, col. 2176.

The low-temperature tar consisting of neutral and acidic oils has been reduced under atmospheric pressure between 400° and 500° by using catalyzers prepared from Fe-Cr-kieselguhr, yellow ocher, and other material. When the reduction was performed at 480° with the yellow ocher from Niwasaka, Fukushima Prefacture, Japan, the low-temperature tar was easily converted to neutral and light oils and the catalyzers could be regenerated by repeated baking and reduction. It is concluded that the industrialization of this reduction process is possible by using a cycle (each takes 20 minutes) composed of catalytic reaction, baking, and reduction of the catalyzers.

35. FUSHIZAKI, Y., OGAWA, M., AND KANADA, Y. [Average Constants of Constituents of Middle Oil From Low-Temperature Tar.] Jour. Fuel Soc. Japan, vol. 32, 1953, pp. 511-513; Chem. Abs.,vol. 48, 1954, col. 5481.

The constituents of low-temperature tar fraction (200° to 300°), which is secured from the so-called middle oil from the Lurgi oven in Wakamatsu, are studied. Contents of acid, base, and olefin are estimated by acid and alkali treatments. For the constituents of neutral oil, which are not absorbed by above treatment, the ring analysis (Waterman method) is applied. From these tests the distribution of each component at 200° and 300°, respectively, is: Acid 43 to 38, base 12 to 4, olefin 19 to 9, aromatic ring 10 to 13, naphthene ring 7 to 3, and paraffin cain 18 to 13 percent.

36. FUSHIZAKI, Y., OGAWA, M., AND KUBO, Y. [Separation and Analysis of Middle Oil by Absorption From Low-Temperature Tar.] Jour. Fuel Soc. Japan, vol. 32, 1953, pp. 513-518; Chem. Abs., vol. 48, 1954, col. 5481.

Analysis of a neutral fraction (208° to 216.5°) from middle oil is carried out by chromatographic adsorption. Silica gel is used as an adsorbent, and a displacement-development procedure is applied. The separation of constituents of middle-oil fraction is not as easy as of light fraction. The constituents of this fraction are considered to be aromatic and naphthenic hydrocarbons mostly, and a small quantity of crystalline naphthalene is isolated.

FUSHIZAKI, Y. See abs. 87.

GEBERT, F. See abs. 156.

GOEBEL, E. H. See abs. 50.

37. GOLIMER, W. [Experiences in Coking and Low-Temperature Distillation With Saar and Lorraine Coals.] Stahl u. Eisen vol. 62, 1942, pp. 789-795; Chem. Abs.,vol. 37, 1943, col. 5222.

Improved results are obtained only by the addition of hard coal. Apparatus is described and illustrated. Chemical compositions of tars and low-temperature retort gases are given.

38. GOMEZ, M., GOODMAN, J. B., AND PARRY, V. F. Changes Induced in Low-Temperature Tar by Oxidation and Storage. Bureau of Mines, Rept. of Investigations 5227, 1956, 12 pp.; Chem. Abs.,vol. 50, 1956, col. 11645.

Freshly produced primary tars are light-yellow materials that darken on exposure to air and light. Sandow (Texas lignite) and Delcarbon (Colorado, high-volatile B bituminous coal) tars obtained from fluidized carbonization in an externally heated retort were studied. The tars had a specific gravity of 1.050 and 1.151, respectively. The pour point for both tars occurred in the range from 25° to 30°. Aging of the Sandow tar decreased the olefin fraction 14.8 volume-percent (total, dry tar) shown by fresh

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tar to 9.9 volume-percent (total, dry tar) after 90 days' storage. The tar acids decreased from 19.2 volume-percent yielded by the sample stored 90 days. The paraffin plus naphthalene fraction of the lignite tar showed 14.4 volume-percent decrease after 90 days' storage. The tar bases decreased only slightly. The aromatic fraction showed a minimum at about 30 days' storage (16.8 volume-percent, total, dry tar to 10.3 volume-percent).

39. GOMEZ, M., GOODMAN, J. B., AND PARRY, V. F. Low-Temperature Tar From Fluidized Carbonizing Reactors. Bureau of Mines Rept. of Investigations 5302, 1957, 44 pp.; Chem. Abs., vol. 51, 1957, col. 6980.

Detailed summary of tar data derived from the carbonization experimental work conducted by the Bureau Laboratories of Region II in Denver. Analytical data covering 20 low-temperature tars, derived from the carbonization of various ranks of foreign and domestic coals, are tabulated. It is seen that in techniques that use entrainment or fluidization of the coal particle, carbonization conditions are secondary to coal rank with respect to tar-oil yields and composition.

GOODMAN, J. B. See abs. 38, 39.

GORIN, E. See abs. 168.

40. GOSSEDIN, A. [Evaluation of Lignite Tar.] Rev. inst. franç. pétrole et Ann. combustibles liquides, vol. 1, 1946, pp. 145-151; B.C.U.R.A., 1947, abs. 3179; Chem. Abs., vol. 44, 1950, col. 5080.

Tar (d_{15} 1.026, 80 percent volatile at 360°, PhOH content 41 percent) from the low-temperature (450°) carbonization of lignite from Bouches-du-Rhône was hydrogenated in presence of a catalyst based on MoS_2 with a 3:1 H:N mixture. Processing (at 470° per 400 atmosphere) for maximum production of gasoline yielded 86 weight-percent of a product of boiling 55 to 186° and motor octane number 75. An alternative is to hydrogenate with a view to producing solvents and lubricants. For this purpose the tar was separated by distillation (at 20 millimeter, cutting at 220°) into two fractions of equal volume. On hydrogenation (at 300° per 400 atmosphere) the light part yields a gasoline H_2O-soluble cut, a highly aromatic solvent fraction, a heavier cut (280° to 320°) suitable as a plasticizer, and a phenol fraction. The heavier part of the tar is hydrogenated (at 380° per 400 atmosphere) to give spindle oil and lubricating oil of medium η (11.2 centistokes at 98.2°), moderate η index (64), good pour point (-7°), and good oxidizing characteristics. The overall yield of products from the two portions is 86.9 percent (gasoline and solvent 32, light phenols 9.7, spindle oil 14.2, medium lubricating oil 25.7, wax, 5.3 percent).

41. GOVOROVA, R. P. [Production of Engine Fuels From Low-Temperature Tar From Ukrainian Brown Coals and Examination of Its Gasoline Fraction.] Avtoref. diss. Kand. tekh. Nauk, Inst. Teploenerg. Akad. Nauk Ukr. S.S.R. Title in Ref. Zh. Khim., Moscow, 1956, (15) 41826D; Fuel Abs., vol. 21, 1957, abs. 4204.

Thesis, 1955.

GOVOROVA, R. P. See abs. 101.

42. GREBER, W. [Mechanical Preparation of Tar From Low-Temperature Carbonization in Contrast to Low-Temperature Hydrogenation.] Chem. Tech. (Berlin), vol. 7, 1955, pp. 530-535; Chem. Abs., vol. 51, 1957, col. 8411.

The rate of filtration of low-temperature carbonization tar is compared with that of the low-temperature hydrogenation product. Empirical volume versus temperature curves are presented. Details are given on particle size and distribution.

43. _____. [Mechanical Purification of Brown-Coal Low-Temperature Tars.] Freiberg. Forsch. vol. A36, 1955, pp. 110-134; Chem. Abs.,vol. 50, 1956, col. 4482.

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The filtration speed of brown-coal low-temperature tar, which is freed of slimy compounds depends only upon its dust content. Screen analyses of dust obtained by evaporation of the filter cake at 10^{-5} millimeter Hg pressure and 320[6] showed that a difficultly filtered tar had a normal particle-size distribution (I), while an easily filtered tar had an abnormal I. The average pore radius of the macropore system was the same for both easily and difficultly filtered tars; hence I had no influence on average macropore radii. The pressure had no effect on big pores, but influenced the volume of the micropore system. Methods and apparatus for the determination of the exterior particle volume V_k, of the volume of solid substance V_o, and of pore-size are described. The accessible pore volume V_2 was calculated as $V_2 = V_k - V_o$. Using the coarsest particles from centrifuging as filter aid in the next filtration increased the filtration speed but did not improve the purification effect.

44. _____. [The Need for a Knowledge of Porous Systems and Methods of Investigating Them in Low-Temperature Hydrogenation TTH-Process.] Erdöl u. Kohle, vol. 9, 1956, pp. 616-620; Fuel Abs., vol. 21, 1957, abs. 4179; Chem. Abs.,vol. 51, 1957, col. 1593.

The low-temperature hydrogenation of tar is described, and the need for a low-ash content in the feed product is emphasized. Methods of investigation developed after the war to examine the variations in quality of the catalysts and in the filter materials and filtration rates of low-temperature brown-coal tars are discussed.

45. GREENHOW, E. J. Chemicals From Coal Tar. Chem. Eng. and Min. Rev., vol. 48, 1956, pp. 333-339.

Methods of producing coal tar and separating tar into its more valuable components and more important uses is discussed; tar production and utilization is compared for Australia, United Kingdom, United States, Western Germany, and France.

GRIGOLEIT, G. See abs. 93.

GRIGOREVA, K. V. See abs. 79.

HAFERKORN, H. See abs. 103.

HAMACHER, K. A. See abs. 31, 32.

46. HANSEN, C. J. [Low-Temperature Tar From Bituminous Coal and Its Further Treatment.] Brennstoff-Chem., vol. 31, 1950, pp. 308-317; Chem. Abs.,vol. 45, 1951, col. 846.

High-temperature carbonization of bituminous coal yields only 3 to 4 percent tar, as compared with 8 to 10 percent or even more for low-temperature carbonization. The yield of phenols is 20 to 30 times as great from the low-temperature tar. Five conditions that must be met by a satisfactory low-temperature carbonization process are: (1) Applicability to all kinds and sorts of coal, suitable for low-temperature carbonization, (2) manufacture of strong semicoke in suitable size, (3) maintenance of suitable cracking conditions throughout the system and uniform temperature conditions to give the highest possible tar uniformity, (4) a satisfactory throughput at the desired temperature, (5) smooth and trouble-free oven operation. The only method that satisfies all of these conditions is the Brennstoff-Technik (BT) process, in which iron retorts with movable walls are used. One disadvantage of most of the other processes is the high-pitch content of the tar; pitch values are compared graphically for tars from the various low-temperature carbonization processes, showing the minimum values (30 to 35 percent) obtained with the BT process. These tars are topped to 180° and then distilled to 350° to 360° giving a tar oil amounting to 43 to 45 percent of the tar weight. This tar oil is extracted with 7 percent NaOH solution to remove phenols; the solution is then treated with CO_2-containing gases to precipitate phenols, which are then fractionated. The resulting neutral oil and the phenol-containing oil are good Diesel fuels, with high-cetane numbers; the neutral oil can be fractionated to

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give oils of high-, medium-, and low-cetane number.

Attempts to fractionate the tar oil by solvents have not proved commercially useful. However, the tar can be diluted with low-temperature light oil and phenols extracted with NaOH solution without distillation. Some difficulty is found, owing to the simultaneous extraction of viscous resins, and other products that are readily removed from the phenols by distillation.

47. HANSEN, C. J. [New Viewpoints in Refining Low-Temperature Tars.] Brennstoff-Chem., vol. 34, 1953, pp. 4-6; Chem. Abs., vol. 47, 1953, col. 5097.

Conventional methods of refining tars are unsatisfactory for low-temperature tars, especially those from brown coal. Tars from heated-surface carbonization apparatus are easier to refine than those from the recirculated-gas processes, and the following procedure is better adapted to the former. The tar (preferably of low viscosity) is diluted with solvent naphtha from low-temperature carbonization so that it is possible to precipitate out the maximum quantity of hard asphalt on standing and also much of the dust contained in the tar; this treatment prevents emulsion formation in later treatment. The C_6H_6-insoluble fraction of the tar should be reduced to 0.02 percent or less by this treatment. Phenols are then extracted with dilute NaOH solution. The remaining oil has a low viscosity, stability during storage, a calorific value of 9,800 kcal. per kg., and a C + H content of 95 percent and higher. This oil is suitable for heavy-oil engines. Further treatment of the phenol fraction is by unpublished methods, which yield phenol fractions comparable in color with those from coke-oven tars. This refining is carried out more readily with the phenol fraction boiling up to about 225° (including xylenols). The process is capable of producing satisfactory phenols from brown-coal tar. A low-temperature tar from bituminous coal gave 65-percent heating oil, 22-percent "pure" phenols, and 10-percent phenolic pitch. A graphic chart is given for the pitch content of a variety of low-temperature tars as compared with gas-works and coke-oven tars.

48. HARA, N., OSAWA, M., AND AZUMA, H. [Extraction of Low-Temperature Tar by Various Alcohols.] Jour. Chem. Soc. (Japan), vol. 51, 1948, pp. 150-152.

MeOH was the most effective of the alcohols tested (MeOH to pentanol) in extracting acid components from low-temperature tar, boiling 200° to 300°; d_4^{35}, 0.9380; acid oil, 31 percent; and basic oil, 2 percent. The optimum concentrations of MeOH were 70 to 80 percent for 1 extraction and 70 to 75 percent for repeated or continuous extractions when the solvent-tar ratio was 1:1. By 2 to 3 extractions neutral oil could be separated in about 90-percent yield including >3 percent acidic oil.

HATTORI, S. See abs. 162.

HAYASHI, K. See abs. 34.

HEINICHEN, G. See abs. 26.

49. HEINZE, R. [Low-Temperature Tar and Oil: Properties and Applications.] Gas-u. Wasserfach, vol. 85, 1942, pp. 413-425; Chem. Abs., vol. 37, 1943, col. 5847.

In Germany the value of low-temperature tar is largely dependent on its fuel fractions; these vary with the coal and the method of carbonization (external heating or recirculated gases). Brown-coal tars can be processed by distillation, cracking under pressure, hydrogenation under pressure (largest volume of tar is processed by this method) and by solvent extraction, with EtOH, SO_2 or phenol. Each of these processes is discussed in detail. In the pressure-hydrogenation process, 1.25 kilogram of brown-coal tar yields approximately 1 kilogram of gasoline with an octane number of 60 to 70. Low-temperature tars from

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bituminous coals can be hydrogenated readily but are not well adapted to solvent extraction. Attempts should be made to produce tar approximating the desired characteristics for fuel directly from the carbonizing apparatus. For laboratory carbonization tests, an approximation to results secured by externally heated retorts is secured by using an insert consisting of a series of perforated trays in the 200-gram Fischer aluminum retort; this reduces the capacity to 100 gram. Fractional condensation is used to separate heavy oil, middle oil, and liquor; low-boiling products are condensed at -20° by solid CO_2.

50. HEINZE, R. E., AND GOEBEL, E. H. [Dust and Asphalt Content of Coal Tar and Coal-Tar Oils From Low-Temperature Carbonization] Erdöl u. Kohle, vol. 2, 1949, pp. 397-400; B.C.U.R.A., 1949, p. 7262; Chem. Abs.,vol. 44, 1950, col. 308.

The purity of a tar from low-temperature carbonization of coal is not determined by its percentage of xylene insolubles. Theoretically the insolubles should consist only of dust, mineral matter, and amorphous C all of which are insoluble in organic solvents. Pyridine and butanone left the least residue and had therefore the greatest solubility. In addition, the following solvents were tested: CCl_4, dichloroethylene, EtOH, ether, benzene, acetone, aniline, CS_2, and Et and iso-Bu acetates.

HONDA, H. See abs. 84.

HULSEMANN, H. See abs. 156.

51. IBING, -., AND FRESE, -. [Experiments on Hydrogenation of Pitch From Low-Temperature Carbonization of Hard Coal.] Bd. Tr., German Div. Doc. Unit, F.D. 3479, 1948, 46 frames; Fuel Abs.,vol. 6, 1949, abs. 587.

I. G. FARBENINDUSTRIE, A. G. See abs. 29.

IHARA, I. See abs. 110.

IHNATOWICZ, M. See abs. 140.

52. IKEDA, H. [The Plant Hormone-Like Action of Low-Temperature Coal Tar. Part I. Effect on the Growth of Rice Plant.] Jour. Agr. Chem. Soc. Japan, vol. 21, 1946, p. 21; Chem. Abs.,vol. 45, 1951, col. 4867.

The acidic part (A) and basic part (B) of the high-boiling fraction of low-temperature coal tar, both insoluble in H_2O, were made into pastes with gum arabic and emulsified with H_2O. When rice seed was soaked in 0.005 to 0.0001 percent (preferably 0.0002 to 0.0001 percent) solutions of A or B at 28° to 30° for 24 hours, the growth of the young plants, especially the roots, was better than that of the control. In the second method the rice seedlings were cultured in solutions of A or B for a week; 0.005 to 0.002-percent solutions (especially 0.005-percent A) inhibited growth, while 0.001 to 0.0001-percent solutions gave better growth than the control and those treated with 0.000001-percent K 1-naphthaleneacetate. The beneficial effect was more marked with B. Water cultures showed that dilute A and especially B solution gave better results in yield of rice (dry weight of ears compared with 3.4 gram for the control was: A 0.005 percent 1.5; 0.002 percent 5.2; 0.001 percent 5.2; 0.0005 percent 7.5. B 0.005 percent 2.0; 0.002 percent 6.5; 0.001 percent 6.0; 0.0005 percent 10.0 gram).

Part II. Effect on the Growth of Rice Plant. Vol. 22, 1948,pp. 18-19.

Pot and field experiments showed similar beneficial effect of A and especially B on the growth of the plants. Higher concentrations were necessary for these applications than for water cultures. The time of using B or A was of importance.

53. ISHIDA, K., AND MATSUKI, Y. [Treatment of the Original Low-Temperature Tar With Liquid Ammonia.] Bull. Chem. Research Inst. Nonaqueous

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Sols., Tohôku Univ., vol. 2, 1952, pp. 51-59; Chem. Abs., vol. 48, 1954, col. 7283.

Tar acids can be well extracted by liquid NH_3. Quantitative data are given.

54. ISHIDA, K. [Solvent Refining of Low-Temperature Tar With Liquid Ammonia.] Science Repts. Research Inst. Tohôku Univ. Ser. A., vol. 5, 1953, pp. 377-394; Chem. Abs., vol. 48, 1954, col. 9045.

The middle fractions of low-temperature tar were treated with mixed solutions of H_2O and liquid NH_3 at 0° and 20°, and with liquid NH_3 at -10, 0, +10, and 20°, and phase equilibrium between tar acids, neutral oil, and solvents were studied. The distribution ratio ranged from less than 1 to greater than 1 when the solvent contained about 20 percent (by weight) H_2O. When the solvent contained less than 85 percent (by weight) NH_3, the yield of extract was small but the purity of phenols in the extracted oil was above 90 percent. Solvent containing about 85 percent NH_3 (by weight) is considered optimum for separating tar acids from oils. A novel definition is proposed for solvent selectivity as the difference between the concentration of the solute in the extract layer, on a solvent-free basis, and the concentration in the raffinate layer.

ISHIDA, K. See abs. 111.

ISHIKAWA, H. See abs. 90.

55. ISOBE, H., AND TAKIZAWA, M. [Low-Temperature Tar.] Bull. Inst. Phys. Chem. Research (Tokyo) vol. 21, 1942, pp. 438-447; Chem. Abs., vol. 43, 1949, col. 8641.

Experiments on the tar evolved during the low-temperature carbonization of coals are described. Coals used were subbituminous, and low-grade and high-grade bituminous. The crude tar contained tar acids 30 to 35 and tar bases 4 to 6 percent by volume and comprised oil boiling up to 300°, 50 to 57, and oil, boiling at 300° to 350°, 20 to 23 percent by volume. The remainder, or neutral oil, contained oil, boiling up to 300°, 47 to 56, and oil, boiling 300° to 350°, volume of tar oil up to 350° in the neutral oil increased with decreasing grade from about 77 and 80 percent for the high-grade bituminous coal to about 86 and 89 percent for the subbituminous coals. For the high-grade bituminous coal the volume of tar oil up to 270° in the crude tar and oil up to 300° in the neutral oil showed increases of about 5 to 9 and 8 to 9 percent as compared with the other coals of lower grade.

Bull. Inst. Phys. Chem. Research (Tokyo), vol. 21, 1942, pp. 520-536.

The tar vapor, total tarry matter, water, and gaseous matter, which was evolved during low-temperature carbonization (up to 550°), were introduced into the catalyst chamber with no catalyst and then condensed by the coolers. A subbituminous coal was used. The operating temperatures of the catalyst chamber were about 450°, 500°, and 550°. The chief effects of increases in temperature were a decrease in the yield of tarry matter, a considerable decrease of neutral oil, but no decrease of tar acid and base, an increase in the yield of gaseous matter, a marked decrease in the neutral-oil content of the tar evolved up to about 380° or 400° during the carbonization, a considerable decrease in the neutral-oil content of the tar-oil fraction boiling at 270° to 350° or 300° to 350°, in the crude tar, and an increase in the fraction boiling over 350°, in the crude tar.

Bull. Inst. Phys. Chem. Research (Tokyo), vol. 21, 1942, pp. 644-650.

The analysis of the neutral oil, boiling up to 350°, in the crude tar evolved during low-temperature carbonization is described. The coals used were two subbituminous, and a low- and high-grade bituminous coal. Items covered are

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operating temperature, boiling range, percentage of total neutral oil, specific gravity at 25°, percentage of olefins, aromatics and saturates in the neutral oil, and specific gravity and η of the saturates at 20°.

56. IYENGAR, M. S. [Viscosity of Tar From Low-Temperature Carbonization.] Jour. Sci. Ind. Research (India),vol. 11B, 1952, pp. 14-18; Chem. Abs.,vol. 47, 1953, col. 2455.

Paraffinoid coal tar obtained by low-temperature carbonization of Hyderabad (India) coal sets into a solid mass when heated with water and lime for 2 hours at 70°, whereby the lime combines with the tar acids and enhances the viscosity of the tar and makes it suitable for use as road binder.

Jour. Sci. Ind. Research (India), vol. 11B, 1952, pp. 18-19.

Dehydration increases the viscosities of low-temperature coal tar and producer-gas tar, which is ascribed to the molecular association in the phenolic fraction of the tars and the presence of high-boiling tar acids.

JACOBSON, A. See abs. 147.

57. JÄGER, A. [Quantitative Determination of Acid Oils in Low-Temperature Coal Tar by Means of Fractional Distillation.] Paper to German Chem. Soc., Gen. Assembly, Frankfurt a. M., July 10-15, 1950; Agnew. Chem., vol. 62, 1950, p. 449; Fuel Abs.,vol. 8, 1950, abs. 5148.

The aromatic hydroxy compounds in low-temperature tar were separated, and 75 compounds in the boiling range 180° to 320° isolated by means of fractional distillation in packed columns of at least 45 theoretical plates. Mixtures not separable by fractionation were separated by means of other physico-chemical or chemical methods. Hydroxy compounds with boiling point up to 230° C. were determined quantitatively, as were the phenols present in low-temperature carbonization liquors. With Krupp-Lurgi process of low-temperature carbonization, 1.8 percent phenol, 1.8 percent o-cresol, and 3.6 percent m-p-cresols were formed. The tar contained up to 1.3 percent 1:3:5-xylenol and up to 0.9 percent 1:2:4-xylenol. Of the 12.1 percent $^{v}/_{v}$ of phenol, cresols, and xylenols present in tar, 11.2 percent were determined quantitatively, and 9 hydroxy compounds were identified in the remaining 0.9 percent. On the basis of these investigations, a technical plant that permitted the recovery of pure low-temperature tar phenols and the preparation of a number of different phenol resins from the mixtures was erected.

58. JÄGER, A., AND KATTWINKEL, G. [Aromatic Oxygen Compounds Boiling From 180° to 225° From Acid Oils in Low-Temperature Tar.] Brennstoff-Chem.,vol. 31, 1950, pp. 65-79; Chem. Abs., vol. 44, 1950, col. 5561.

To determine the composition of the Krupp-Lurgi low-temperature coal tar and to develop methods for isolating the various compounds a quantitative investigation was made of the dry tar acid mixture. The aromatic O compounds boiling up to 225° were secured by fractionation with 1 of the several columns that are described. Large volumes of tar were fractionated under vacuum in an apparatus with a 10-liter flask, electrically heated, and provided with a fractionating column (packed) with a jacket supplied by recirculated oil, externally heated. This is described in detail. Large volumes were fractionated to give sufficient quantities of the O compounds. The method of fractional extraction, not described herein, made the separation of the acid oils by fractional distillation much easier. The aromatic O compounds present in greatest proportion are relatively easily isolated; those that are present in small quantities and are more difficult to separate can be removed as a mixture, which can be hydrogenated directly to solvents. Phenols and cresols are formed in about equal fractions in low-temperature carbonization. Of the various xylenols, the sym-xylenol is present to the greatest extent. As yet, the weakly acid

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1-hydroxy- 2,6-dimethylbenzene and the o-ethylphenol can only be isolated by chlorination of the fraction remaining after the removal of phenol. O compounds with longer side chains than C_2 were present only to a very slight extent. At the temperature of formation of these tars, side chains of three or more C atoms formed closed ring compounds (indan derivatives, etc.). Little change appears to occur up to 225° in the fractionation of these acid oils.

59. _____. [Neutral Constituents of Low-Temperature Coal Tar, Especially Light Oil Boiling at 134° to 188°.] Brennstoff-Chem., vol. 35, 1954, pp. 353-362; Chem. Abs., vol. 49, 1955, col. 4264.

The 25 kilogram of light oil (boiling range 100° to 200°) used in this investigation came from the Velsen low-temperature coal-distillation plant. This light oil was fractionated into 2 overhead fractions and residue, and the 2 overhead fractions were refractionated to give 17-kilogram product, boiling 134° to 188°, used in this study. This fraction was subjected to further fractionation, and chemical and chromatographic separations were used. The n-paraffins and aromatic hydrocarbons were determined as accurately as possible; only a few qualitative determinations were possible on the isoparaffin-naphthene mixture because of its complexity. Results were checked by means of infrared analysis; especially as to the identity of the materials isolated.

Thirty-four substances have been identified: 20 were aromatics; 4, n-paraffins; 6, naphthenes; and 3, iso-paraffins. Of the sulfur compounds, only the 2,5-dimethylthiophene could be identified by infrared analysis.

60. _____. [Identification of Some Hydrocarbons in Low-Temperature Coal Tar.] Erdöl u. Kohle, vol. 8, 1955, pp. 629-636.

The neutral-oil fraction boiling 20° to 56° contained acetone, 2-butanone, 1-pentene, cyclopentene, 2-methyl-2-butene, cyclopentadiene, 1,3-pentadiene, cyclopentane, and 2-methylpentane. The fraction boiling 56 to 100° contained 1-hexene, benzene, methylcyclopentadiene, cyclohexene, 1 heptene, and smaller amounts of 2-methyl-2-pentene, methylcyclopentene, 2-methyl-2-hexene, 2-methyl-pentane, hexane, methylcyclopentane, cyclohexane, 2-methylhexane, heptane, methylcyclohexane, and small amounts of cyclopentane. The fraction boiling 100° to 136° contained toluene, 1-octene, m- and p-xylene, branched olefins that were not identified, methylcyclohexane, 2- and 3-methylheptane, octane, and small quantities of heptane. The composition of the fraction boiling 130° to 188° was previously described (see Chem. Abs. vol. 44, col. 5562). The fraction boiling 200° to 230° contained naphthalene, dodecane, tridecane, 1-methylnaphthalene, 2-methylnaphthalene, 1-dodecene, 1-tridecene, methylbenzenes.

Part II. Estimation. Erdöl u. Kohle, vol. 8, 1955, pp. 706-711.

Tables are presented for all compounds identified in low-temperature coal tar. This tar is compared with coking tar and midcontinental petroleum.

61. _____. [On the Ketones of Low-Temperature-Carbonization Coal Tar.] Erdöl u. Kohle, (German), vol. 9, July 1956, pp. 447-450; B.C.U.R.A., vol. 20, 1956, abs. 4168.

The isolation, from ketonic compounds of low-temperature-carbonization tars, of pentanone-2, hexanone-2, heptanone-2, octanone-2, 1-methylcyclopentanone-2, and 3-methylbutanone-2 is reported.

62. JAHN, A. [Light-Oil Recovery in the Low-Temperature Carbonization of Brown Coal.] Braunkohle vol. 43, Nos. 9, 10, 1944, pp. 73-80, Chem. Abs., vol. 38, 1944, col. 6072.

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The various methods used for low-temperature carbonization of brown coal are reviewed as well as the effect of the method of carbonization on the properties and yields of light oil and tar. The composition of the light oil varied considerably with the coal and the method used. Light oil from the low-temperature distillation of brown coal contains relatively high contents of unsaturated hydrocarbons and variable content of phenols and S compounds, depending on the coal. Light oil, recovered at the Leopold mine from low-temperature carbonization of brown coal by the recirculated gas process, had a specific gravity of 0.854; by the Kosag process, 0.798; creosote contents were 21.0 and 3.7 percent, respectively; S compounds, 2.10 and 2.95 percent; unsaturated hydrocarbons 47.6 and 43.4 percent; aromatic hydrocarbons 20.0 and 27.6 percent, naphthenes, 0.0 and 10.5 percent; and paraffins 32.4 and 18.8 percent, respectively. Light oil is best recovered from low-temperature-carbonization gas by oil scrubbing; the use of active C would require preliminary removal of S compounds, which would be quite expensive.

63. JÄPPELT, A. [Low-Temperature Carbonization of Bituminous Coal in Shallow Beds.] Glückauf, vol. 78, 1942, pp. 249-252; Chem. Abs., vol. 37, 1943, col. 5845.

The technique already adopted for distilling brown coal in shallow beds can be successfully applied to noncaking or only slightly caking bituminous coals of 10-millimeter size containing 10 percent of H_2O. By suitable design of the retort, especially of the gas offtakes, the tar vapors are made to remain longer in the retort. The improvement in tar quality thus effected by cracking is accompanied by a decreased tar yield. A powdery coke suitable for pulverized-fuel firing of boilers, gasification, and other processes is obtained. Typical analyses of the gas and tar are tabulated.

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64. JÄPPELT, A., AND KLAUS, J. [Distillation of Tar and Tar Fractions in the Presence of Surface-Active Coke.] Oel u. Kohle, vol. 39, 1943, pp. 569-574; Chem. Abs., vol. 38, 1944, col. 2187.

The tar obtained by low-temperature carbonization of Upper Silesian gas coke and fractions from this tar were distilled in the presence of different grades of coke dust with varying surface activity; the coke had been activated by steam in the course of its production by low-temperature carbonization. The surface activity of the coke dusts was measured by determining the heat of wetting with C_6H_6. Tar and coke dust, both anhydrous, were mixed in a kneading machine in such proportions that the capillaries of the dust were saturated and enough "externally" bound tar was present to premit briquetting. The briquets were distilled without cracking and with steam as heating medium. The yield and quality of the distillate depended on the magnitude of the internal surface of the coke dust used; a mixture of a very active coke from brown coal and tar yielded a distillate with Conradson carbon residue of 1.34 percent, asphalt content 6.1 percent and η_{20} 5.4° E. as compared with C residue of 10.95 percent, asphalt content 33.5 percent and η_{20} 123.6° E. of the distillate obtained in the absence of surface-active coke. Even higher-boiling fractions can be improved by this treatment, although it is preferable to use oils with an initial boiling point below 300°. The ratio of oil to adsorbent is not critical, but better results were obtained with higher percentages of added coke dust. The process in its present form is not suited for the conversion of crude creosote to useful phenols.

65. JONES, B. W., AND NEUWORTH, M. B., Thermal Cracking of Alkyl Phenols., Conversion of High Boiling Phenols. Ind. Eng. Chem., vol. 45, 1953, pp. 2704-2705; Chem. Abs., vol. 48, 1954, col. 1661.

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Studies on the thermal cracking of the high-boiling phenolic fraction of low-temperature tar show that the highest yields of low-boiling phenols occur at 770° to 775°, 0.05 second-residence time, and a steam to feedstock-weight ratio of 2. Increasing the cracking temperature results in a decrease in yield of low-boiling phenols and a corresponding decrease in neutral hydrocarbons.

66. JONES, D. C., KELLY, T. E., AND NEUWORTH, M. B., Moving Bed Contact Coking Apparatus. Ind. Eng. Chem., vol. 46, 1954, pp. 12-15; Chem. Abs., vol. 48, 1954, col. 3014.

In connection with development of low-temperature carbonization of coal, which produces considerable yields of tar pitches, an investigation was made into the possibility of coking these pitches to recover liquid byproducts and a low-ash coke for electrometallurgical use. For this purpose a miniature moving bed contact-coking apparatus was designed, from which basic-process data were obtained from less than 1 pound of liquid feed. The apparatus has other applications.

67. JONES, J. P. Edeleanu G.m.b.H., Altenburg, CIOS Rept. XXXI-85, 1946, 73 pp.; Petrol. Times, vol. 50, 1946, p. 293.

Reports on advances in theory and practice made by the Edeleanu Co. and equipment manufacturers with their solvent extraction and dewaxing processes. The triangular coordinate system of presenting data from extraction work has been supplemented by the author by a graphical method, using rectangular coordinates, from which can be derived information that cannot be deduced from the triangular coordinate system of presentation. A novel optical method, employing polarized red light, is described for determining the wax content of between 20- and 60-percent-wax content wax-oil mixture. Short notes discussed the catalytic cracking of diesel oil to lower its pour point; this work was started on the basis of discussions with the Anglo-Iranian Oil Co. The effect of simple catalysts described acting on a diesel fuel containing 5 to 8 percent of wax is to reduce its pour point from about 6° C. to about -15° C. The percentage yields are given as diesel-fuel oil, 85 percent; gasoline, 10 percent; and residue 5 percent. Statistics made by Germans "from memory" are given briefly for German oil supplies and on "hydrocarbon material" from brown-coal tar. More than two thirds of the report is a translation of a paper entitled "The Use of Selective Solvents to Separate Various Fractions From Tar Produced by Low-Temperature Carbonization of Brown Coal and Oil Shale," read on June 26, 1942, by Prof. Ernst Torres (Edeleanu Co.) to members of The German Brown Coal Industrial Organization. Emphasis is placed on the unique, continuous band-filter and its use for the dewaxing of solvent-extracted brown-coal-tar distillates to yield valued diesel oil, waxes, electrode coke, and navy-fuel oil with a specific gravity greater than sea water.

68. KAHLES, E. [Hydroxyhydrindene in Coal Tar From Low-Temperature Carbonization.] Ber. deut. chem. Gesell., vol. 75B, 1942, pp. 1313-1315; Chem. Abs., vol. 37, 1943, col. 4881.

A phenol fraction b_{12} 120° to 125° (143 gm.) was diluted with 75 cubic centimeters 4.5 percent NaOH, the alkaline solution acidified with dilute H_2SO_4, the phenols were taken up in ether, the H_2SO_4 was removed with H_2O and the presence of 4-hydroxyhydrindene (I) in the phenol residue established by preparing the phenylurethan and the phenoxyacetic acid (with chloroacetic acid); I could not be isolated as the benzoate.

69. KALECHITS, I. V., POPOVA, N. I., AND SALIMGAREEVA, F. G. [Application of Chromatographic-Adsorption Analysis to a Study of the Low-Temperature Coal Tar.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R. Ser. Khim., No. 3, 1955, pp. 5-12; Chem. Abs., vol. 50, 1956, col. 7428.

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Tar fraction (184° to 325°) was investigated by chromatographic-adsorption analysis. The chromatographic column was a U-shaped glass tube filled with 500 milliliter of silica gel (class 65 to 150-mesh) with an adsorbing capacity of 17.3 milliliter per 100 gram. The tar fraction was adsorbed by the silica gel and then recovered by the following organic solvents, listed in order of increasing desorption capacity: Petroleum ether, C_6H_6, acetone, alcohol + benzene. The rewashed products were separated from the solvents by distillation and heating in a stream of N. This method makes possible the separation of individual hydrocarbons in the tar.

70. KALECHITS, I. V., POPOVA, N. I., AND SHOROKHOVA, M. V. [Adsorption Series for Components of Low-Temperature Tar.] Trudy Vostoch.-Sibir. Filiala, Akad. Nauk S.S.S.R., Ser. Khim., No. 3, 1955, pp. 13-18; Chem. Abs.,vol. 50, 1956, col. 7429.

Experiments characterizing the order of the desorption of the components of low-temperature tar from silica gel are carried out. The data show that the hydrocarbons (which are desorbed first) are desorbed in the following order: Methane-naphthene, monocyclic, and bicyclic. Within each group the unsaturated compounds are desorbed last. After the hydrocarbons, the neutral O-containing compounds that cannot be saponified and the phenols are desorbed in the following order: Nonsaponifiable O-containing compounds, phenols, substances containing the ester group. To recheck the desorption series the following mixtures were studied: Phenols from the coal-tar fraction up to 325°; esters (diethylphthalate) and nonsaponifiable substances from the same coal-tar fraction; and a mixture of the three. The experimental data lead to the following adsorption series: Paraffin and naphthene hydrocarbons < aliphatic olefins < monocyclic aromatics < bicyclic aromatics < nonsaponifiable neutral O-containing compounds < phenols < bases < esters < tarry substances containing ester groups and double bonds.

71. KALECHITS, I. V., SALIMGAREEVA, F. G., POPOVA, N. I., KURBANGALEEVA, D. K., AND KLYKOVA, G. G. [Detailed Grouping and Functional Composition of Neutral Substances in Low-Temperature Tar.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R. Ser. Khim., No. 3, 1955, pp. 19-24; Chem. Abs., vol. 50, 1956, col. 7429.

The grouping and the functional composition of the neutral substances in coal tar were characterized by means of adsorption on silica gel with subsequent chemical analysis of each fraction. The neutral materials were obtained by consecutive treatment of a C_6H_6 solution of coal tar with 10 percent alkali and 5 percent H_2SO_4 to remove the phenols and the bases. The data show that of the neutral substances (only 75 percent were identified) 40.5 percent were aromatic hydrocarbons. Based on a study of all of the data, it was proposed that 90 percent of the composition of coal tars is aromatic. The physical constants of the separated fractions were determined and are presented in tabular form.

72. KALECHITS, I. V., SALIMGAREEVA, F. G., AND TUMBUSOVA, Z. P. [Application of Adsorption Analysis to the Investigation of Phenols and Bases in Low-Temperature Tar.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R. Ser. Khim., No. 3, 1955, pp. 30-34.

The use of chromatographic adsorption for the separation of mono- and bicyclic phenols and bases from coal tar and from its hydrogenation products were studied with o-cresol, β-naphthol, pyridine, and quinoline. Experimental data show that Al_2O_3 was preferable for separating phenols, but that silica gel was better for the bases. The best order of use of the developers was as follows: C_6H_6, Et_2O, EtOH. The data show that the destructive hydrogenation process degrades the higher series phenols to lower ones.

73. KALECHITS, I. V., AND SALIMGAREEVA, F. G. [Formation of the Phenols in the Process of the Destructive

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Hydrogenation of the Low-Temperature Tar.] Trudy Vostoch.-Sibir. Filiala, Akad. Nauk S.S.S.R., Ser. Khim. No. 3, 1955, pp. 79-87; Chem. Abs., vol. 50, 1956, col. 7429.

Effect of various factors - contact time, temperature, and pressure - on the destructive hydrogenation of the phenols from Cheremkhov coal tar was studied. The experimental results showed that the best yield of the low-molecular-weight phenols was obtained at 480° to 490° and 300 to 340 atmosphere. The effect of the contact time was found to be relatively insignificant. The mechanism for the formation of low-molecular-weight phenols was studied, and it was found that the main source of the low-molecular-weight phenols in liquid-phase hydrogenation are the high-molecular-weight phenols and the acid asphaltenes.

KALECHITS, I. V. See abs. 123.

KANADA, Y. See abs. 35.

74. KARAVAEV, N. M., AND BLONSKAYA, A. I. [Chemical Composition of the Neutral Oil of the Primary Tar of Minusinsk Coal.] Trudy Inst. Goryuchilk Iskopaemykh, Akad. Nauk S.S.S.R., vol. 2, 1950, pp. 236-246; Chem. Abs.,vol. 49, 1955, col. 4263.

The neutral oil consisted mainly of aromatic and unsaturated hydrocarbons: The former were mostly homologues of benzene, with no naphthalenes; among the latter were found C_8H_{16}, C_9H_{18}, $C_{10}H_{20}$ and $C_{11}H_{22}$, with the double bond in the α or β position. There were also some saturated C_{10} to C_{15} hydrocarbons, mainly paraffins but with 15 to 18 percent of naphthenes.

75. KARAVAEV, N. M., FADEICHEVA, A. G., AND KUZNETSOV, V. I. [Composition of Phenols in the Primary Tar of (Bituminous) Brown Coal of the Ukranian S.S.R.] Khim. i Tekhnol, Topliva i Masel, No. 3, 1957, pp. 19-24; Chem. Abs., vol. 51, 1957, col. 14239.

The phenol content in the low-temperature carbonization tar of brown coal is higher than in high-temperature coking tar, and the tar obtained in the carbonization of briquets in the Pintsch ovens was investigated after its separation at the carbonization plant. The phenol-containing fraction was extracted with 13 percent NaOH. The phenols were fractionated into narrow fractions at 8- to 9-millimeter pressure, and the fractions were identified by their melting point, n, OH content, analysis, and the melting point of their arylglycolic acids. Lower phenols (44 percent) were found in the crude-phenol fraction, including 6 percent of crystalline PhOH, melting point 34°; o-C_6H_4(Me)OH, melting point 27°; 9.25 percent m- and o-cresols, with 32 percent m-cresol in the mixture EtC_6H_4OH formed 4.5 percent of the crude phenols, and consisted of o-, m-, and p-ethylphenols, 1,4,2-, 1,3,4-, 1,3,5-, and 1,2,4-xylenols.

76. KATO, J., TAKESHITA, K., AND TERAJIMA, N. [Analysis and Polymerization of Olefins From Low-Temperature Tar.] Kogaku Iho, Kyushu Univ., vol. 24, 1951, pp. 66-70; Chem. Abs., vol. 47, 1953, col. 5672.

Olefins separated from low-temperature coal tar (I) by treating with methanolic $Hg(OAc)_2$ are chiefly of aromatic nature, whereas olefins extracted with furfural-cresol (3:2) are rich in aliphatic paraffins and olefins. The combination of both methods is recommended for the isolation of aliphatic olefins from I. Both samples of olefins are polymerized by $AlCl_3$, and their properties as lubricants are compared.

77. KATO, T., AND TAKESHITA, K. [Hydration of Olefins in Light Oil From Low-Temperature Tar.] Kogaku Iho (Shuho), Kyusha Univ., vol. 25, 1952, pp. 136-139; Chem. Abs., vol. 47, 1953, col. 12792.

Light-oil fractions from the low-temperature coal tar, boiling ranges of

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which were 150° to 180°, 180° to 210°, and 210° to 240°, were treated with peracetic acid to convert olefins into glycols. Hydration was best carried out at 70°, and most of the olefins were converted into glycols, but others remained unattacked. Properties of the resulting glycols were not fully investigated.

78. KATO, T., AND TERASHIMA, N. [Extraction and Separation of Tar Acids From Low-Temperature Coal Tar.] Kōgaku Ihō, Kyusha Univ., vol. 27, 1955, pp. 129-133; Chem. Abs., vol. 49, 1955, col. 15211.

Extraction of low-temperature coal tar by 60 percent aqueous methyl alcohol gave a purer tar acid, but its yield was poorer than with more concentrated solvents.

KATTWINKEL, G. See abs. 58, 59, 60, 61.

KAWAMURA, T. See abs. 34.

79. KAZOKOV, E. I., AND GRIGOREVA, K. V. [Investigation of Nature of "Asphaltenes" From Humic Tars.] Zhur. Priklad. Khim., vol. 26, January 1953, pp. 96-100; Fuel Abs., vol. 15, 1954, abs. 4375.

Substances insoluble in petroleum ether (30° to 65° C.) and soluble in benzene were yielded (13 to 19 percent) by low-temperature tars from peat and coal. Tars were preliminarily dewaxed with acetone. "Asphaltenes" can be divided into basic (11 to 15 percent) phenolic (53 to 60 percent), and neutral (25 to 30 percent) components; analyses are presented. Their molecular weight (280 to 370) is much less than that of asphaltenes from petroleum (about 3,000). Tar "asphaltenes" have high content of nitrogen (1.7 to 2.7 percent) and oxygen (13-14.7 percent).

KELLY, T. E. See abs. 66.

80. KERR, T. H. Some Studies of Ohio Coals, Shales, and Oils. Ohio State Univ. Studies Eng. Expt. Sta. Bull. No. 133, vol. 17, No. 3, 1948, 63 pp.; Chem. Abs., vol. 43, 1949, col. 375.

A progress report of studies undertaken to determine the possibility of producing oil from Ohio coal and shale. These data are furnished: Ash content of 20 samples of coal; results of distillation and analytical examination of crude tar-oil obtained from the low-temperature carbonization of Ohio coal; fractionation results after cracking the crude-tar oil; crude-oil composition and residues after distillation; and analyses of Ohio oil shale.

KHOPATA, G. N. See abs. 19.

KIGEL, T. B. See abs. 101, 102.

81. KIKKAWA, S. [Constituents of Solid Paraffin Contained in Low-Temperature Tar Pitch.] Jour. Chem. Soc. Japan, Ind. Chem. Sec., vol. 54, 1951, pp. 637-639; Chem. Abs., vol. 47, 1953, col. 7195.

The carbon disulfide-soluble part of low-temperature tar pitch was fractionated under vacuum at the temperature intervals of 10°, and the content of sulphonation residue and solid paraffin in each fraction was established. In the distillate obtained up to 300° and 4 millimeter mercury, the higher the boiling point of the fraction, the smaller the paraffin content. The molecular weight, melting point, and viscosity index of purified paraffins were determined. These paraffins seem to consist mainly of a series of normal paraffins with 24 to 32 carbon atoms.

82. _____. [Mean Properties of Low-Temperature Tar Pitch.] Jour. Chem. Soc. Japan, Ind. Chem. Sec., vol. 54, 1951, pp. 790-792; Chem. Abs., vol. 47, 1953, col. 7761.

The soluble part of low-temperature tar pitch in carbon disulfide was fractionated under a vacuum of 4 millimeter mercury at various temperatures with the

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interval 10°. Elementary analysis and determination of melting point, molecular weight, specific gravity, and refractive indices were carried out for each fraction, and the results are tabulated. Anthracene, pyrene, and chrysene were not found in the fractions.

83. _____. [Constitution of Low-Temperature Tar Pitch.] Jour. Fuel Soc. Japan, vol. 32, 1953, pp. 405-409; Chem. Abs.,vol. 48, 1954, col. 5481.

To clarify the constitution of low-temperature tar pitch, a chromatograph is applied to the narrow-cut fraction, the boiling range of which is 220° to 230° per 4 millimeter Hg. The results are: (1) The atmosphere of the saturated hydrocarbon in the sample fraction is about 10 percent, 50 percent of which is considered the normal paraffin with a C number ranging from C_{28} to C_{29}. From the results of recrystallization of these urea adducts with pyridine, it is judged that some isoparaffin and long-chain alkyl compounds exist in the adduct. (2) The unsaturated compounds are chiefly found in the aromatic part of the samples. (3) The overall mean properties of the sample fraction show considerably higher paraffinicity, compared with those of the high-temperature tar pitch, little difference is found in the aromatic nature of the high- and low-temperature tar pitches except the saturation; the number of condensed rings seems to be about three. (4) The aromatic parts contain O, N, and S compounds, and some of the compounds have two or more atoms of O, N, and S in one molecule.

84. KIKKAWA, S., HONDA, H., AND OUCHI, K. [Magnetic Properties of Pitches.] Jour. Fuel Soc. Japan, vol. 32, 1953, pp. 535-540; Chem. Abs.,vol. 48, 1954, col. 5481.

The magnetic properties of pitches - low-temperature tar pitch, high-temperature tar pitch, and pitch oil - each has a different degree of thermal cracking, are measured by the Gouy method. From these results and the properties already ascertained, the relation between the degree of thermal cracking and the properties of the pitches is concluded as follows: (1) Magnetic susceptibility X_g of the low-temperature tar pitch is somewhat larger than that of the high-temperature tar pitch or the pitch oil, judging from the degree of paraffinic nature of the samples. (2) The calibrated X_g values are calculated by excluding the paraffin and the O, N, and S atoms in order to see the magnitude of X_g of the aromatic components. The relation of the X_g between the low-temperature tar pitch and the high-temperature tar pitch or the pitch oil runs parallel to the relation of the X_g mentioned in (1) above. (3) The X_g values of the high-temperature tar pitch and the pitch oil are somewhat smaller than those of the pure condensed aromatics, such as anthracene, pyrene, and other aromatics. These pitches probably contain other types of hydrocarbons with different configuration from the condensed aromatics. (4) The $\Delta K/\Delta K_b$ values obtained from X_g agree with the number of condensed rings.

85. KIKKAWA, S., AND YAMADA, F. [Analysis of Low-Temperature Tar Fractions.] Jour. Chem. Soc. Japan, Ind. Chem. Sec., vol. 55, 1952, pp. 100-101; Chem. Abs.,vol. 47, 1953, col. 10203.

A preliminary comparative study was made on the applicability of the methods commonly used for the type analysis of petroleum products to the low-temperature tar fractions. The usability of chromatography was also studied.

86. _____. [Light Oil Fraction From Low-Temperature Tar.] Jour. Chem. Soc. Japan, vol. 55, 1952, pp. 158-160; Chem. Abs.,vol. 47, 1953, col. 10203.

Neutral part of light oil from low-temperature tar was fractionated into several fractions by means of a rectification tube 1 millimeter long and 1.5 centimeter in diameter. From the

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determination of boiling point and refractive indexes of the products, it is shown that separation into paraffin, cycloolefin, and aromatic hydrocarbons is possible by the use of fractionation and chromatography. Toluol and methyl cyclohexane-like substances were separated from the fraction at 108° to 110°.

87. KIKKAWA, S., KO, K., AND FUSHIZAKI, Y. [Constitution of Wax From Low-Temperature Tar.] Jour. Chem. Soc. Japan, Ind. Chem. Sec., vol. 56, 1953, pp. 464-466; Chem. Abs.,vol. 48, 1954, col. 11031.

A low-temperature tar wax having melting point of approximately 40° boiling point of 90° to 243° per 1 millimeter Hg, 20 percent olefins, 28 percent aromatic compounds and 52 percent saturated hydrocarbons was distilled into many fractions from 120° to 240°, and the melting point and index of refraction were examined. The variation of melting point with refractive index showed good linearity. The separation of normal paraffins (I) by preparing addition compounds with urea was tried. I with the longer chains could be easily purified by this method. The molecular weight determinations revealed that I contained in the examined wax are mainly of C_{13}-C_{25}.

88. KIKKAWA, S., AND YAMADA, F. [Properties and Constituents of Low-Temperature Tar-Naphtha.] Jour. Fuel Soc. Japan, vol. 32, 1953, pp. 507-510; Chem. Abs.,vol. 48, 1954, col. 5481.

Low-temperature tar-naphtha is fractionated into 30 fractions of 5° intervals each. Some physical properties of each fraction - η, specific gravity, molecular weight, and other properties - are determined, and the distribution of aromatic, olefinic, and paraffinic hydrocarbons is measured. Detection of some aromatic constituents is attempted, and benzene and m-xylene are found. Some paraffins, with carbon numbers 7-11, are isolated by means of extractive crystallization with urea adduct.

KINGMAN, F. E. T. See abs. 15.

89. KISHIDA, M., AND CHUTO, M. [Cracking of Low-Temperature Coal Tar.] Coal Tar (Kooru Taaru), vol. 4, 1952, pp. 398-402; Chem. Abs., vol. 47, 1953, col. 6120.

Heavy oil fractions of low-temperature coal tar were thermally cracked in a steel vessel at 400° to 800° under atmospheric or reduced pressure. The best yields of gaseous olefins were obtained at 700° and -10 millimeter Hg ; the yield of C_2H_4 was 10.3 weight-percent and C_3H_6 8.6 weight-percent.

KITAHARA, A. See abs. 153.

KLAUS, J. See abs. 64.

KLYKÔVA, G. G. See abs. 71, 123.

KO, K. See abs. 87.

90. KOBAYASHI, K., AND ISHIKAWA, H. [Catalytic Cracking and Contact Refining of Low-Temperature Tar With Japanese Acid Clay.] Jour. Soc. Chem. Ind. (Japan), vol. 45, 1942, pp. 1171-1174; Chem. Abs., vol. 43, 1949, col. 7667.

To utilize low-temperature tar effectively it was distilled with the addition of Japanese acid earth. The effect on various constituents in the tar was investigated.

KOBAYASHI, T. See abs. 2.

KOGA, M. See abs. 153.

91. KOHLENTECHNIK, G.m.b.H. [Production and Investigation of Low-Temperature Coal Tar.] Westdeutscher Verlag. Cologne, 1953, 63 pp., DM. 13.75; Chem. Age, vol. 71, July 24, 1954, p. 183.

Research into low-temperature carbonization has recently been stimulated because this process can be applied to coals that are not suitable for treatment by the usual high-temperature

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method. However, in spite of the value of the coke produced by low-temperature carbonization as a smokeless fuel, this process has not proved economical in Germany. Research has therefore been directed towards a more profitable utilization of the tar, and this government publication reports experiments on its detailed analysis by distillation and other methods. The book also includes descriptions of the various types of plant used for low-temperature carbonization and presents a brief history of the process.

KOHLES, E. See abs. 1.

KOPPERS CO. See abs. 8.

KORSHUNOV, V. I. See abs. 133.

KO-WE NIEDERSCHACHTOFEN G.m.b.H. See abs. 118.

92. KRUBER, O. [Working Up of Low-Temperature Tars by Means of Solvents.] Reichsamt Wirtschaftsausbau, U. S. Dept. Commerce, Off. Tech. Serv., PB L52,005, June 1940, pp. 27-39; Bib. Sci. Ind. Repts., vol. 7, 1947, p. 574; Fuel Abs., vol. 3, 1948, abs. 2955.

Five flowsheets and one drawing of equipment help to illustrate theoretical and engineering aspects of the treatment of various kinds of tars with selective solvents.

93. KRUBER, O., RAEITHEL, A., AND GRIGOLEIT, G. [Compounds Proved To Be Present in Coal Tar.] Erdöl u. Kohle, vol. 8, 1955, pp. 637-643; Chem. Abs., vol. 50, 1956, col. 8175.

Two hundred and eighty-two compounds are given in sequence of increasing boiling points; structural formulas, melting points, and references are included.

KUBO, Y. See abs. 36.

94. KULIK, H. D. (Pittsburgh Consolidation Coal Co.) Process for Removing Finely Divided Solids From Raw Low-Temperature Carbonization Coal Tars, U. S. Patent 2,774,716, 1956; Fuel Abs., vol. 19, 1957, abs. 3268.

A process for removing solids consisting essentially of finely divided solid particles from the class of coal and partially devolatilized coal from raw, low-temperature-carbonization tar comprises mixing the raw tar with 0.5 to 3.0 volumes of a predominantly non-aromatic low-temperature carbonization-tar distillate fraction containing at least 2 percent by volume of tar acids, separating rejected pitch and agglomerated solids, and recovering the liquids.

KURBAN-GALEEVA, D. K. See abs. 71, 123, 124, 127.

95. KUROKAWA, M., AND ASAOKA, N. [Hydrogenation of Extracted Oils From Low-Temperature Tar.] Jour. Soc. Chem. Ind. (Japan), vol. 44, 1941, pp. 737-740; Chem. Abs., vol. 42, 1948, col. 2086.

The low-temperature tar obtained from Yubetsu coal was fractionated by extraction according to Steinbrecher and Kühn (Chem. Abs. vol. 31, col. 8898), and the fractions were separately hydrogenated at 450° under initial pressure of 100 atmospheres with the catalyst MoO_3 + S(6:1), or the catalyst NiO. The yield and the density of oily hydrogenation product decreased in the order: Olefins, aromatic compounds, cycloölefins, naphthenes, paraffins; the gasoline fraction of the product increased in the same order. For production of low-boiling fractions by hydrogenation Mo + S was the more effective catalyst with olefins, aromatic compounds, and cycloölefins; NiO was more effective with naphthenes and paraffins. The gasolines produced fall, according to their properties, into the groups: (a) Those obtained from olefins and aromatic compounds, (b) those from other hydrocarbons; or, (a) those from olefins and aromatic compounds, (b) those from cycloölefins and naphtheones, (c) those from paraffins.

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96. KUWATA, T., AND ONOMOTO, M. [Phenol Treatment of Low-Temperature Tar.] Jour. Soc. Chem. Ind. (Japan), vol. 46, 1943, pp. 971-973; Chem. Abs., vol. 42, 1948, col. 6088.

A gas-oil fraction of low-temperature tar produced by the Lurgi plant distilling at 220° to 350° and composed of 60 and 40 percent of neutral and acid oil, respectively, was treated with a 5:1 mixture of PhOH and H_2O. When 30 percent of the solvent-gas-oil fraction was used, 45 percent was extracted and 55 percent left undissolved. The residual part when purified with NaOH, or other material gave a yellow mobile oil that consisted mainly of saturated hydrocarbons and was suitable for high-speed Diesel fuel or cracking stock. The extract was a brown viscous oil of density 1.05 and contained 70 percent of higher phenols and 30 percent hydrocarbons of which 81, 18, and 1 percent were aromatic, unsaturated, and saturated compounds, respectively.

97. KUWATA, T., AND UEDA, H. [Manufacture of Gasoline From Low-Temperature Tar.] Jour. Soc. Chem. Ind. (Japan), vol. 47, 1944, pp. 627-629; Chem. Abs., vol. 42, 1948, col. 6088.

See preceding abstract. Low-temperature tar free from pitch was extracted with aqueous phenol. The purified oil was rich in paraffin. The density was 0.877. The gasoline obtained by thermal decomposition of the oil contained unsaturated hydrocarbons (6, 10 percent). Purification with H_2SO_4 was very easy and the loss was small. The purified gasoline was stable, but its octane value was low (<50). The extracted oil on destructive hydrogenation with Mo catalyst yielded aromatic gasoline of octane value 78. The addition of $PbEt_4$ (0.1 percent) gave an octane number of 90.

98. KUZNETSOV, V. I., AND FADEICHEVA, A. G. Complex Utilization of the Ukrainian Brown Coals. X. [Characteristics of Low-Temperature Carbonization Tar Obtained From Ukrainian Bituminous Brown Coal.] Ukrain. Kehm. Zhur., vol. 21, 1955, pp. 522-526; Chem. Abs., vol. 50, 1956, col. 8169.

Bituminous brown coals from the Aleksandriya deposits underwent low-temperature-carbonization experiments in two stages as follows: (a) In a laboratory rotating retort at 500° to 540°, charged by 7.5 kilogram of brown coal, and (b) in industrial conditions, for example, one briquetted coal in a vertical retort at 580° to 600° of heating medium (gas). The proximate analysis of the brown coals charged in experiments a and b, respectively, were Wr 12.9, 25.4; A_D 14.6, 17.3; Vc 68.7, 65.1; S_D 3.9 - .4/ The yield of carbonization products (percent of dry coal) was, respectively, semicoke 58.8, 58.6; low-temperature tar 11.9, 13.7; pyrolytic water 7.4, 10.0; benzine from gas 0.6, 0.6; gas and wastes 21.3, 17.3. The low-temperature tar had d_{20} 0.9566 and 0.9766, and contained free carbon 4.0, 4.0; bases 0.5, 12.7; organic acids 0.6, 1.6; phenols 10.2, 9.4; asphaltenes 0.9, 1.0; paraffins 13.2, 12.6; silica-gel tars 17.5, 16.3; and neutral-hydrocarbon matters (liquid) 53.1, 51.8. The results of fractional distillations of the low temperature tars and detarred analysis of their fractions are given. It is concluded that considerable high yield of low-temperature tar (13.7 percent) having high contents of paraffins (13 percent), saturated as well as aromatic hydrocarbons (about 40 percent), and phenols (10 percent) makes the tar a prospective raw material for chemical use.

99. KUZNETSOV, V. I., AND BOBROVA, A. A. [Physical Properties and Component Contents of Brown Coal Tars Obtained in Semicoking With a Solid Heat Transfer Semicoke.] Ukrain. Khem. Zhur., vol. 21, 1955, pp. 664-668; Chem. Abs., vol. 50, 1956, col. 8994.

4/ Wr means water (as fed); A_D means ash (as delivered); Vc means volatile matter (dry); S_D means sulfur (as delivered).

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Tar obtained in low-temperature carbonization of brown coals with brown-coal semicoke as a heat-transfer medium contains more water and dust, has a lower drop point, and a higher specific gravity, and contains more asphaltene and less paraffin than does tar from the same coal produced in rotating retorts or in shaft kilns. The brown-coal semicoke used as a heat-transfer medium produces partial thermal cracking of the fuel and polymerization of the products of secondary decompositions. The yield of asphaltenes is lowered when the carbonization temperature is raised.

100. KUZNETSOV, V. I., AND BOBROVA, A. A. [Low-Temperature Carbonization of the Preliminary Extracted Coals.] Ukrain. Khem. Zhur., vol. 21, 1955, pp. 800-803; Chem. Abs.,vol. 50, 1956, col. 17382.

Brown coal with 22.6 percent of bitumen (ash-moisture free basis) was carbonized in an Al retort before and after extraction by various organic solvents. The most effective extractants were alcohol-benzene (1:1) and dichloroethane-alcohol (3:1). Carbonization of the preliminary extracted coals decreased the yield of tar from 25.7 percent to 9.1 - 14.7 percent and several tar components, that is paraffin, from 4.5 to 0.5 - 3.4 percent. The yield of semicoke and gas was virtually the same whether originating from raw or extracted coals.

101. KUZNETSOV, V. I., GOVOROVA, R. P., FADEICHEVA, A. G., KIGEL, T. B., AND CHERNYKH, M. K. [Ukrainian Brown-Coal Tars Recovered at Low-Temperature Carbonization With Solid Heating Medium.] Ukrain. Khem. Zhur., vol. 22, 1955, pp. 804-809; Chem. Abs., vol. 50, 1956, col. 17382.

Three samples of tar were recovered in the laboratory from brown coals carbonized at 375° to 456° ± 25° in a retort with inner heating by solid circulating medium, namely, semicoke (ratio: 4 or 3:1) first heated to 700°. One comparative (parallel) experiment was carried out in a retort with inner heating by inert gases entering l retort at 580° to 600° and leaving it at 115° to 120°. The tars that were recovered from the retort with the solid heating medium contained a high percentage of coal dust and moisture, which were separated from the tars in supercentrifuges (15,000 r.p.m.). Four samples of cleaned tars were fractionated in a Cu flask with a 2-ball fractional column. Several fractions were separated within the following temperatures: Petroleum ether I up to 170°; petroleum ether II up to 200°, ligroine 200° to 230°; kerosine 230° to 290°; and paraffin 290° to 345° (or 360°). The tars from the retort with the solid-heating medium are characterized by increased yield of the petroleum-ether fraction (16.3 or 19.3 percent) and decreased yield of the paraffin fraction (15.1 or 21.2 percent) in comparison with those of tar from the retort with gas heating (5.9 percent of the petroleum ether fraction and 36.5 percent of paraffin fraction). The yield of paraffin from the paraffin fraction also decreased from 90.6 percent to 62.6 - 74.3 percent. This result shows that in the first case the carbonized products were cracked to a higher degree than those from the retort with gas heating. In raw phenols recovered from fractions of investigated tars, the yield of the phenol-cresol fraction (182° to 204°) decreased from 25.9 percent to 13.0 - 18.9 percent.

102. KUZNETSOV, V. I., AND KIGEL, T. B. [Purification of Paraffin Obtained From Lignite Tar.] Ukrain. Khem. Zhur., vol. 22, 1956, pp. 118-121; Chem. Abs., vol. 50, 1956, col. 17383.

Purification of paraffin (I) consists in a selective-solvent, $(CH_2)_2Cl_2$, treatment at 50°. The ratio of solvent to I is 5:1, followed by an air purge, treatment at 120° with 1 percent H_2SO_4, and finally a 2-hour treatment with bentonite at 120°. It gives a white odorless I that hardens at a temperature of 53° for the hard I and of 46° for the soft I; the yield is 68 and 33 percent, respectively (calculated on the weight of the crude I).

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KUZNETSOV, V. I. See abs. 75.

103. LAMBRIS, G., AND HAFERKORN, H. [New Method for the Exact Determination of Phenols in Low-Temperature Tar and Tar Oils.] Erdöl u. Kohle, vol. 2, 1949, pp. 238-240; Chem. Abs., vol. 43, 1949, col. 7667.

A 3-gram sample of water-free tar or tar oil containing approximately 50 percent phenols is dissolved in a mixture of benzene and xylene and a known excess of a 20 percent KOH solution of known normality saturated with benzene and xylene is added. Weight of the KOH is determined by difference. This mixture is shaken repeatedly in a 300-milliliter separatory funnel. After standing for 0.5 hour, the dark or almost black phenolate solution containing the major portion is separated and weighed. Care must be taken to prevent the induction of solids. The phenolate in the residue is extracted with hot water and titrated with 0.2N HCl and 1 ml. Congo red (1:100). If water is present in the tar or tar oil, 100 ml. of xylene is added immediately after weighing and the water separated by distillation the weight of which must be determined. Any phenols carried over are dissolved in the small quantity of xylene in the distillate. This quantity is added to the bulk of the xylene. After any remaining phenols are extracted from the tar residue with boiling benzene, the benzene-xylene mixture is treated with KOH as above. The accuracy of the method is estimated to be ± 1 percent as shown by experiments with phenol; o-, m-, and p-cresol; cresol mixture; and pyrocatechol. The weight of the dissolved phenols X is determined by $X = c - a + cd/[ab - d]$ where a = weight of KOH, b = HCl used per gram of KOH, c = weight of major portion of phenolate solution, which is formed by shaking the phenol solution with KOH, d = HCl used for titration of phenolate residue.

104. LANDA, S., ROMOVACEK, J., AND ROMOVACKOVA, H. [Paraffins From Brown-Coal Tar.] Chem. listy, vol. 49, 1955, pp. 313-316; Chem. Abs., vol. 49, 1955, col. 9259.

Low-temperature brown-coal tar was washed with 3 percent NaOH, with 5 percent H_2SO_4, and steam-distilled to give 20 percent of an oil, d_{25} 0.8972, η_D^{25} 1.493, melting -42°. The oil was distilled on a 54 TP column, and fractions having low refractive indexes were cooled with dry ice after being diluted with 1.5 volume Me_2CO. In this way, the following paraffins were isolated (melting point, boiling point, d_{20}, d_{25}, η_D^{20}, η_D^{25}): Decane, -29.6°, b_{752} 173°, 0.7298, 0.7261, 1.4130, 1.4102; undecane, -26.7°, b_{100} 127°, 0.7400, 0.7363, 1.4190, 1.4161; dodecane, -12.25°, b_{753} 215°, 0.7519, 0.7488, 1.4218, 1.4190; tridecane, -7.2°, b_{50} 141°, 0.7599, 0.7560, 1.4280, 1.4255; tetradecane, 5.25°, b_{56} 159.8°, 0.7674, 0.7641, 1.4315, 1.4306; pentadecane, 9.10° b_{50} 172°, 0.7740, 0.7708, 1.4335, 1.4314. Isolation of dodecane (fraction 119.4 to 121.7° at 47 millimeter) required chromatography to remove the admixture of naphthalene. Infrared spectra of the hydrocarbons are presented.

105. LANDA, S., AND MOSTECKY, J. [o-Alkylphenols From Low-Temperature Brown-Coal Tar.] Chem. listy, vol. 50, 1956, pp. 391-393; Collection Czechoslov. Chem. Communs., vol. 22, 1957, pp. 629-631; Chem. Abs., vol. 50, 1956, col. 7428.

Treating the 200° to 220° xylenol fraction from a low-temperature brown-coal tar (16 Kg.) with 16 liters of 30 percent sodium hydroxide, extracting the solution with 22 liters diethyl ether, and evaporating the diethyl ether up to 50° in vacuo gave 306 gram (1.9 percent) of a phenol mixture, boiling at 10 millimeter pressure at 92° to 98.6°. Treatment of the mixture with mono-chloro-acetic acid gave, after crystallization from water and petroleum ether, a product, melting at 121.30°, probably a eutetic mixture of aryloxy-acetic acids. Methylation of the phenolic mixture (obtained by the diethyl ether extraction) with methyl sulfate and distilling the mixture of phenolic methyl ethers gave fraction I (C_7) boiling at 37 millimeter pressure, at 85.7°

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to 86.4°, fraction II (C_8), boiling at 37 millimeter pressure at 100.2° to 101.0°, and fraction III (C_9), boiling at 37 millimeter pressure, at 102.7 to 103.5°. Fraction I gave on oxidation with 5 percent potassium permanganate phenoxyl acetic acid (IV) melting at 100°, fraction II gave IV and 1,3,2-C_6H_3 $(CO_2H)_2$ OCH, and fraction III gave a mixture, which was not separated into pure compounds. The oxidation thus shows the presence of cresol, ethyl phenol, and 2,1,3-xylenol in the extract.

106. LANDA, S., ROMOVACEK, J., AND ROMOVACKOVA, H. [Azulenes From Low-Temperature Brown-Coal Tar.] Chem. listy, vol. 50, 1956, pp. 1964-1968; Chem. Abs., vol. 51, 1957, col. 3965.

Rectification of the neutral part of middle oil yielded 2 blue fractions, b_{47} 142° to 147° and 159° to 161°, containing azulene and 2-methylazulene (I) which were extracted with H_3PO_4 and identified as adducts with $C_6H_3(NO_2)_3$ and by spectra. Countercurrent extraction of the neutral part with concentrated H_3PO_4 followed by chromatography on Al_2O_3 yielded an azulene concentrate containing I, dimethylazulene substituted in 2, 4, 6, or 8, and a mixture of higher methylated azulenes.

107. LANG, E. W. Low-Temperature Carbonization Will Reduce Fuel Costs. Elec. Light and Power, vol. 35, 1957, pp. 88-91; Chem. Abs., vol. 51, 1957, col. 10031.

Carbonization of pulverized America Seam coal in a fluidized bed at 950° F. results in conversion to char 80, tar 10, H_2O 5.3, and gas 4.7 percent. Eighty percent of original heating value is recovered as char and product gas. Sale of tar, at current prices, can result in net reduction of heating costs. Agglomeration of coal particles is prevented by high-flow velocity and by recycling char particles, which are then partially burned in the reactor to provide heat for process.

108. LANIN, V. A., MOKHUN, L. M., AND EDEMSKAYA, N. D. [Phenol Production From Cresols From Low-Temperature Carbonization Tar From Bituminous Coal.] Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, No. 10, 1956, p. 128; Chem. Abs., vol. 51, 1957, col. 9126.

Lurgi tar was fractionated into the below 210° and 210° to 320° fractions. Phenols were extracted with 13 percent NaOH solution and separated with CO_2 or SO_3. To purify the phenols, 0.5 to 1 percent of HPO_3 was added, which polymerizes the tarry materials, and combines with the N bases present. To obtain phenols, which do not become rose-colored during storage in air, a small quantity of powdered $KMnO_4$ (or H_2O_2) was added to the phenols at room temperature, and the products were distilled with a 93 percent yield of the phenol-cresol fraction, which was separated by fractionation.

LANIN, V. A. See abs. 27, 133.

109. LOWENSTEIN-LOM. W. [Pyrocatechol From Low-Temperature Tar.] Petroleum (London), vol. 13, 1950, pp. 61-62; Chem. Abs., vol. 44, 1950, col. 3698.

A method for production and purification of pyrocatechol (I) from low-temperature carbonization effluents was described. Phenosolvan, a mixture of isobutyl, butyl, and amyl acetates, was used for extraction of I from the effluent. After removing most of the solvent by distillation the separation was completed by batch vacuum distillation at 25 to 50 millimeter Hg. The 4th fraction, containing I 49.2, I homologues 31.1, o-cresol 6.8, xylenols 7.3, and higher boiling material and residue 5.6 percent, was treated in a purification pilot plant, which was described. This fraction was dissolved in an equal weight of C_6H_6, then cooled. I was crystallized out in a vacuum crystallizer, centrifuged, and washed with C_6H_6, dried in a rotating-plate drier and taken

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to storage. The purified I melted 100° to 102° and contained 4 to 8 percent homologues or other impurities. A further recrystallization raised its purity to 99.2 percent. Plant capacities and production costs are given.

MASINOVA, J. See abs. 131.

MATSUKI, Y. See abs. 53, 111.

110. MATSUMOTO, K., AND IHARA, I. [Tar Bases in Low-Temperature Coal Tar.] Coal Tar (Kooru Taaru) vol. 3, 1951, pp. 224-227; Chem. Abs., vol. 46, 1952, col. 7741.

Tar bases were separated from the fraction, boiling <190°, of the low-temperature carbonization tar for Ube coal and subjected to fractional distillation and chemical analysis. The lower homologues of C_5H_5N were separated as salts with $HgCl_2$ or $(COOH)_2$ and the higher homologue as picrates; 16 bases were identified: C_5H_5N, 2-, 3-, and 4-picoline, 2,3-, 2,4-, 2,5-, 2,6-, and 3,4-lutidine, 2,3,4-, 2,4,5-, 2,4,6-, and 2,3,6-trimethylpyridine, and 2,4-methylethylpyridine. Among these homologues the presence of C_5H_5N with much 3-picoline and 2,6-lutidine was characteristic.

111. MATSUMOTO, Y., AND ISHIDA, K. [Treatment of Low-Temperature Tar by Liquid Ammonia. Part I. Extraction of Tar by a Batch Process.] Jour. Chem. Soc. Japan, vol. 52, 1949, pp. 92-94; Chem. Abs., vol. 45, 1951, cols. 2179, 4428.

The solvent extraction method gives the neutral (I) as well as the acidic (II) and alkaline (III) oils, which can be used as raw materials, and makes possible the recovery of the solvent for repeated use. The possibility of this was indicated by Fischer and others (Chem. Abs., vol. 14, col. 2071; vol. 26, cols. 2577, 3651). Liquid NH_3 was tested as a solvent at 20° to -10° and was found suitable for use at low temperature. The selectivity of extracting I, II, and III reaches a maximum when the amount of solvent used is 30 to 50 percent of the sample oil to be extracted.

Part II. Jour. Chem. Soc. Japan, vol. 52, 1949, pp. 189-191

As a continuation of the researches on the extraction of oils from low-temperature tar with NH_3, results obtained with use of the Soxhlet apparatus are shown. Acidic oils were extracted completely and basic ones with a yield of more than 90 percent. Oils have low values in density and in η and are lighter in color and less odorous than those obtained by a simple extraction apparatus. They can be used as efficient fuels for Diesel engines. Desulfuration is not much expected. A nomogram of the extraction efficiency was constructed.

Part III. Change of the Composition of Refined Oil. Jour. Chem. Soc. Japan, vol. 53, 1950, pp. 28-30; Chem. Abs., vol. 46, 1952, col. 8357.

Neutral oil is prepared by washing low-temperature tar with H_2SO_4 and NaOH, and its solution in liquid NH_3 has been studied at -10° to 20°. The presence of acidic oil promotes more or less the solution of neutral oil. The influence of temperature is slight.

Part IV. Influence of Tar Acids on Extraction. Jour. Chem. Soc. Japan, vol. 53, 1950, pp. 245-247; Chem. Abs., vol. 46, 1952, col. 10587.

Crude tar having different tar-acids content has been extracted with liquid ammonia at 0° and 20°. The changes of the quantity of neutral oil in the extract with tar-acid content are summarized.

Part V. Extraction With Concentrated Ammonia. Jour. Chem. Soc. Japan, vol. 53, 1950, pp. 425-427; Chem. Abs., vol. 47, 1953, col. 294.

In order to determine the influence of water contained in tar upon the extraction by means of liquid NH_3,

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pitch-free low-temperature tar, boiling 149° to 283°, was extracted with concentrated NH_3 at 0° and 20°. The dissolution of acidic oils decreased with increased water content.

Part VI. Effect of Tar Acid Content on Extraction by Liquid Ammonia Containing Water. Jour. Chem. Soc. Japan, vol. 55, 1952, pp. 12-14; Chem. Abs.,vol. 47, 1953, col. 9596.

Crude, pitch-free, low-temperature tar having 15 to 80 percent tar-acid content was treated with liquid ammonia of 0 to 30 percent water content at 0° and 20°, and the results were compared with those of liquid ammonia. It is desirable that the water content either in solvent or raw material is less than 5 percent and that the temperature of extraction is low.

MILES, D. See abs. 5.

112. MINET, R. G., SMITH, H. B., AND TRILLING, C. A. Economics of Coal Carbonization by the Low-Temperature Process. Chem. Eng. Progress, vol. 50, 1954, pp. 342-347; B.C.U.R.A., vol. 18, 1954, abs. 7020.

Discussion of the economics of established processes and of a proposed new process, the latter being a modification of processes previously described in the literature.

113. MINET, R. G. Continuous Fluidized Carbonization of Bituminous Coal. Coal Utilization, vol. 10, 1956, pp. 33-35; B.C.U.R.A.,vol. 20, 1956, abs. 3440.

A 2-stage pilot plant with a capacity of 2 tons per day is described. Continuous fluidized carbonization of a wide range of coal types is claimed to be a working process, which could be economically sound in the United States if markets were developed for the low-temperature tars.

MIRINGOF, N. S. See abs. 160.

MOKHUN, L. M. See abs. 108.

MOSTECKÝ, J. See abs. 105.

114. MUNDERLOH, M. [Dephenolization by Pressure Extraction at the Offleben Low-Temperature Distillation Plant.] Brennstoff-Chem. vol. 36, 1955, pp. 65-67; Chem. Abs., vol. 49, 1955, col. 9259.

The phenols contained in brown-coal-tar oils can be obtained in such a way that these oils are treated with water at elevated temperatures and under pressure (160° and 15 to 20 atmosphere). Thus > 90 percent of the phenolic oils are dissolved. Water concentrated with phenol in this way is then dephenolized by a solvent in the normal manner. Flow diagrams and pictures illustrate the arrangement and operation of the plant. Essentially the process is a modification of the Phenosolvan process.

NAGASAKA, K. See abs. 152.

NAIR, A. P. M. See abs. 150.

115. NEUWORTH, M. B. (Pittsburgh Consolidation Coal Co.) Separation of 2,6-Xylenols From Cresols. U. S. Patent 2,789,146, April 16, 1957. Chem. Abs.,vol. 51, 1957, col. 12473.

Tar-acid oil from low-temperature carbonization of bituminous coal is fractionated, and the cut boiling 180° to 230° is extracted with 30 to 50 percent aqueous MeOH and naphtha to recover phenols free of neutral oils. Upon redistillation, a phenol cut is obtained boiling 190° to 203° and containing 18 percent 2,6-xylenol. Countercurrent extraction with a mixture of 5 parts hexane and 10 parts 45 percent aqueous MeOH decreases the concentration of 2,6-xylenol to 6.8 percent of the cresol fraction recovered from the aqueous MeOH.

NEUWORTH, M. B. See abs. 25, 65, 66.

116. NIKOLI'SKII, N. A. [Formation of Coal Tar During Coking and Some Data

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on Its Composition.] Nauch. Tekh. Konferentsiya v Svyazi s Sorokaletmin Yubileem Uchebno-Nauch. Deyatel'nosti Tomsk Ind. Inst. Tezisy Dokladov, 1940, pp. 125-127; Khim. Referat. Zhur., vol. 4, No. 5, 1941, p. 94; Chem. Abs., vol. 37, 1943, col. 5847.

At low-coking temperatures there are obtained metallurgical coke, tar containing approximately 14 percent of phenols and crude benzene containing 28 percent of toluene. A typical tar specimen contained naphthalene, 6.867; phenanthrene, 6.224; fluoranthrene, 3.480; pyrene, 1.927; chrysene, 0.686; fluorene, 2.214; anthracene, 1.645; acenaphthene, 1.645; and carbazole, 2.203 percent. A small-scale method of production was based on a combination of rectifications and recrystallizations was developed.

OGAWA, M. See abs. 35, 36.

117. OGAWA, T. Studies on Hydrogenation of Low-Temperature Tar. U. S. Naval Tech. Mission to Japan, Index X-38(N)-7, Enclosure (B), vol. 9, 1946, pp. 89-94.

Investigation was made to determine the properties of the products and the effect of different catalysts on the hydrogenation of low-temperature tar from Fushun coal. In the absence of a catalyst, the H_2 consumed and the content of unsaturated hydrocarbons in the gas increased with increasing temperature but the yield of liquid product decreased. The content of acidic substances remained practically constant above 425°. The optimum conditions for producing motor fuel by hydrogenation of low-temperature tar were determined as: Reaction temperature, 450°; pressure, 250 kilogram per square centimeter; and reaction time, 2 hours. Asphaltene content was reduced to 3 to 4 percent. When a catalyst was used, the yield of liquid product was almost constant in all cases, but the properties of the liquid were affected by the catalyst used. Acidic, basic, and asphaltic compounds were reduced to neutral oils by using MoO_3 as a catalyst and the yield of light oil was better using MoS_3 than with NiO, Fe_2O_3, CoS, $AlCl_3$ and $ZnCl_2$.

ONOMOTO, M. See abs. 96.

OSAWA, M. See abs. 48.

118. OTTO, C. & CO. G.m.b.H. KO-WE NIEDERSCHACHTOFEN G.m.b.H., AND FUCHS, W. British Patent 753,975, Aug. 1, 1956; Chem. Abs., vol. 51, 1957, col. 3970.

Gases — blast-furnace gas or the gaseous products from low-temperature carbonization of coal — are freed of the relatively small quantities of tar, which they contain, by heating them to 600° to 700° in the presence of a catalyst. The tar is cracked into permanent gases and nongaseous tarry materials. The latter can be removed by cooling and (or) washing. Coke with a thin pasty coating of montmorillonite is a suitable catalyst.

OUCHI, K. See abs. 84.

119. OZAKI, T. [Composition and Resin-Forming Properties of Tar Acids in Middle Oil Fraction of Low-Temperature Coal Tar.] Coal Tar (Kooru Taaru), vol. 3, 1951, pp. 112-117; Chem. Abs., vol. 46, 1952, col. 7740.

Extracting a middle oil fraction, boiling 180° to 300°, separated from low-temperature coal tar prepared by the Wanishi Iron Foundry, gave 20.3 percent tar acids, which were separated into 45 fractions and analyzed. Phenols were determined quantitatively: Phenol 1.15, o-cresol 6.73, m-cresol 2.73, p-cresol 9.91, 1,4,2-xylenol, 5.7, 1,3,4-xylenol 1.1, 1,3,2-xylenol 0.6, m-ethyl phenol 2.4, 1,2,3-xylenol 3.4, 1,3,5-xylenol 2.4, 1,2,4-xylenol 4.2, mesitol (?) 0.2, and p-isopropyl phenol 0.3 percent. Resin-forming properties of the 45 fractions were compared, and it was found that resin-forming properties decreased with increasing boiling point and finally disappeared in the fractions boiling >280°.

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120. PARANT, A. [Research on the Constituents of Low-Temperature Tar.] Compt. rend. congr. ind. gaz Paris (Assoc. tech. ind. gaz France), vol. 65, 1948, pp. 409-421; Chem. Abs., vol. 46, 1952, col. 5293.

Procedures used in experimenting and identifying about 60 constituents of a low-temperature coal tar are described. Some of these compounds are being produced on a commercial or semicommercial scale. The tar is produced at 475° to 675° and contains about 30 percent phenols.

PARRY, V. F. See abs. 38, 39.

121. PATERA, E. [Behavior of the Low-Temperature Tar Produced at Most During High-Pressure Hydrogenation.] Freiberg, Forsch., A36, Disc. 29-30, 1955, pp. 21-29; Chem. Abs., vol. 50, 1956, col. 4482.

The heat-transfer decrease of exchangers used in the pressure hydrogenation of low-temperature brown-coal tars (I) produced at Most (Brüx, Czechoslovakia) was found to be caused by the polymerization of polyhydric phenols present in I and by the formation of a deposit on heat-transfer surfaces. Detailed information on the behavior of different fractions of I in the hydrogenation preheaters, heat exchangers, and superheaters is given. The electric precipitator tar (II) of Lurgi low-temperature carbonization, as used as Most, contained phenol 0.3, cresols 0.8, and xylenols 1.7 percent. The middle oil of II contained phenol 2.5, cresols 5.2, xylenols 5, and polyhydric phenols (III) 6 to 12.5 percent. III containing pyrocatechol 37, isohomopyrocatechol 13, homopyrocatechol 32, dimethylpyrocatechol 9, and other polyhydric phenols 9 percent. Owing to its low H per C ratio, I must be preheated as quickly as possible and should be processed in mixture with other high H per C ratio tars.

PELČÍK, J. See abs. 122.

PELIPETZ, M. G. See abs. 168.

122. PERNA, F., AND PELČÍK, J. [Hydrogenation of Phenol Fractions of Low-Temperature (Brown Coal) Tar.] Paliva, vol. 31, 1951, pp. 151-155; Chem. Abs., vol. 47, 1953, col. 10200.

Phenolic fractions, boiling 180° to 230°, 230° to 270°, and 270° to 300°, are hydrogenated at 420° per 85 atmospheres (MoO_3 catalyst). The content of aromatic and unsaturated hydrocarbons in the product rises with increasing boiling point of the fraction. The rate of uptake of H_2 and of dehydration of the products is about the same for all fractions.

PETEREIT, H. See abs. 156.

PITTSBURGH COAL CARBONIZATION CO. See abs. 23.

PITTSBURGH CONSOLIDATION COAL COMPANY. See abs. 94, 115.

123. POPOVA, N. I., SALIMGAREEVA, F. G., KLYKÔVA, G. G., SHOROKHOVA, M. V., KURBAN-GALEEVA, D. K., AND KALECHITS, I. V. [Composition of Neutral Substances in the Liquid-Phase Hydrogenated Product From Low-Temperature Coal Tar.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R., Ser. Khim., vol. 3, 1955, pp. 25-29; Chem. Abs., vol. 50, 1956, col. 7429.

The composition of the liquid-phase product of the hydrogenation of coal tar was determined by means of adsorption by using the method described (in abs. 71). The components of the hydrogenated product are similar in their physical constants to those of the coal tar. The hydrogenated product shows a decrease in unsaturation and the conentration of compounds with functional groups. The change in the nature of the O compounds is particularly significant; a decrease in content of OH and ester groups and an increase in the number of carbonyl groups.

124. POPOVA, N. I., KURBAN-GALEEVA, D. K., AND SHOROKHOVA, M. V. [Composition of Low-Temperature Coal Tar.] Trudy Vostoch.-Sibir. Filiala

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Akad. Nauk S.S.S.R., Ser. Khim., vol. 3, 1955, pp. 35-39; Chem. Abs., vol. 50, 1956, col. 7429.

In comparison with the original tar, this fraction shows an increase in the quantity of condensation products and unsaturated aromatic hydrocarbons and a change in the character of the neutral O compounds.

125. POPOVA, N. I., AND SHOROKHOVA, M. V. [Neutral Oxygen Compounds From Low-Temperature Coal Tar.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R., Ser. Khim., vol. 3, 1955, pp. 40-43; Chem. Abs., vol. 50, 1956, col. 7429.

The neutral O compounds of the coal tar were separated from the fraction distilled from the boiling point to 325° by chromatographic adsorption. These compounds had an ester number of 23.6 and gave no qualitative reaction for the carbonyl group. The following fractions were obtained: (1) 82.7 percent non-saponifiable products, (2) 9.5 percent phenols, (3) 7.8 percent carboxylic acids. Fraction 1 was characterized by OH and ester number of 0. The results of the fractional distillation of this fraction are presented in tabular form.

126. POPOVA, N. I., SHOROKHOVA, M. V., AND SAMOĬLOV, S. M. [Chromatographic Separation of the Low-Temperature Coal Tars and Their Hydrogenated Products.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R., Ser. Khim., No. 3, 1955, pp. 44-54; Chem. Abs., vol. 50, 1956, col. 7430.

The specific properties of coal tars, the structure of the aromatic hydrocarbons and the presence of O compounds were studied in relation to the chromatographic separation of coal tars and their hydrogenated products on different samples of silica gel. Data on the separation of individual aromatic hydrocarbons from mixtures with heptane showed that the use of homogeneous, small-pored silica gel is not suitable for separation of the primary coal tars and their hydrogenated products. The activity of silica gel as determined by the adsorption of C_6H_6 is not enough for its characterization. Its activity with respect to the aromatic hydrocarbons must also be determined. The presence of highly resinous products in the primary coal tars causes a sharp decrease in the separating capacity of silica gel, owing to the poisoning of its active centers.

127. POPOVA, N. I., AND KURBAN-GALEEVA, D. K. [Methods for the Determination and Possibilities for Separating Paraffin From the Low-Temperature Tar of the Cheremkhov Basin Coals.] Trudy Vostoch.-Sibir. Filiala Akad. Nauk S.S.S.R., Ser. Khim., No. 3, 1955, pp. 63-71; Chem. Abs., vol. 50, 1956, col. 7430.

A new method is described for separating paraffin from the bitumen of the low-temperature tar produced at the Cheremkhov plant by freezing out the paraffin at 0° from the tar fraction (325° to 450°) from the following solutions: EtOH-Me_2CO (1:1), EtOH-toluene (10:1), EtOH-C_6H_6 (10:1). The best results were obtained with EtOH-Me_2CO (1:1) since under these conditions the impurities (aromatic hydrocarbons) could be washed out with a fivefold to eightfold quantity of the solvent cooled to 0°. The paraffin was similar to that obtained from brown coal.

POPOVA, N. I. See abs. 69, 70, 71.

128. POUND, G. S. Chemicals From "Coalite" Process. Chem. Trade Jour., vol. 128, 1951, pp. 901-903; Fuel Abs., vol. 10, 1951, abs. 169.

Developments in producing chemicals from tar acids from the "Coalite" process for low-temperature carbonization at the Bolsover refinery are described. After a description of cresylic acid recovery, the author describes new production units that have been set up since autumn, 1949. These have included: (1) Plant for producing trixylenyl phosphate; (2) plant for producing various types of chlorinated tar acids; (3) plant for continuous fractional distillation

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of tar acids under automatically controlled conditions; (4) plant for extraction of monohydric and dihydric phenols from ammoniac liquor.

129. _____. Development of Low-Temperature Carbonization of Coal. Jour. Inst. Fuel, vol. 24, 1951, pp. 61-68; Chem. Abs., vol. 45, 1951, col. 4424.

The progress of low-temperature carbonization of bituminous coal during the first half of the present century is reviewed. Many of the processes have failed to justify their inventor's claims, but low-temperature carbonization processes should be of increasing importance in producing smokeless fuel and a high yield of liquid products. The latter products include fuel oil, creosote, pitch residue, motor fuel, and Diesel oil; the whole range of tar acids from phenol to the high-boiling tar acids; and many other materials having specialized uses. Pure chemicals are being manufactured, including pure monohydric and dihydric phenols and their derivatives. Details of the refining plant for liquid products are presented.

130. _____. The Production of Chemicals From Low-Temperature Tar. Part I. Coke and Gas. Vol. 14, 1952, pp. 355-362; Chem. Abs., vol. 47, 1953, col. 3544.

Low-temperature tar obtained in producing Coalite contains large quantities of unsaturated, paraffinic, and naphthenic compounds with phenols in double the yield obtained from horizontal-retort or coke-oven tars.

Part II. Coke and Gas, vol. 14, 1952, pp. 401-407.

A description of the methods employed in producing dihydric phenols and miscellaneous products, including pitch, creosote, various oils and solvents, and chlorinated compounds. Phenols are extracted with BuOAc and processed.

131. PROCHÁZKA, J., AND MAŠINOVÁ, J. [Asphalt Determination in Products of Low-Temperature Carbonization.] Paliva, vol. 33, 1953, pp. 241-246; Chem. Abs., vol. 49, 1955, col. 7835.

Asphalt is determined in a modified Soxhlet extractor with hexane.

132. PRONINA, M. V. [Separation of Neutral Oxygen Compounds From Fractions of Low-Temperature Tars and Other Complex Mixtures.] Doklady Akad. Nauk S.S.S.R., vol. 74, 1950, pp. 115-117; Chem. Abs., vol. 45, 1951, col. 4023.

Neutral O compounds were isolated from the higher fractions (boiling 225° to 300°) of two low-temperature tars, one from Baltic shale (I) and the other from Moscow bituminous coal (II). The d_{20}^{20} and percentages of C, H, S, N, and O of the 2 tar fractions were: (I) 0.8699, 85.08, 11.63, 1.46, 0.21, 1.62; (II) 0.8386, 84.75, 12.64, 1.3, 0.45, 0.86. The tar fractions were diluted with double their volume of petroleum ether and percolated through columns of silica gel (65- to 115-mesh) until all O and N compounds were removed. S-compounds were incompletely removed. This purification reduced gum formation on storage. Part of the adsorbed compounds were eluted from the silica gel with benzene and the rest with acetone. The benzene solution was distilled with a stream of CO_2 and the residue diluted with 5 times the volume of petroleum ether, refluxed 6 hours, and treated with a solution of 20 grams semicarbazide-HCl and 20 grams sodium acetate in 60 milliliters water. The semicarbazones of the ketones present were soluble in the oil and could not be crystallized. The solution was washed with H_2O, dried by heating with Na_2SO_4, and repeatedly filtered through silica gel. The adsorbed compounds were eluted by SO_3, which was then distilled off. The product was recrystallized from petroleum ether, but still contained N and S compounds. These were eliminated by treating with oxalic acid, steam

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distillation, extracting the ketones with SO_3, and fractionally distilling. The ketones thus purified formed white crystalline semicarbazones. The presence of aldehydes could not be established.

RABINOVICH, M. I. See abs. 19.

RAEITHEL, A. See abs. 93.

133. RAVICH, M. B., LANIN, V. A., AND KORSHUNOV, V. I. [Effects of Addition of Sodium Compounds During Low-Temperature Carbonization of Bituminous Coal.] Zhur. Priklad. Khim., vol. 24, 1951, pp. 970-975; Chem. Abs., vol. 48, 1954, col. 8515.

Coals were carbonized with the addition of 2 percent of NaOH, Na_2CO_3, and NaCl. NaOH was most active in the cracking of tars; NaCl brought about a marked change in the composition of carbonization products, with a slight increase in the primary tar yield and reduction in the quantities of gas and light ends, which effect is taken as an indication that NaCl inhibits the cracking of the hydrocarbons formed in the process.

134. REID, J. J. A Study of Several Products of Disco-Type Low-Temperature Coal Tar as Wood Preservatives. Proc. Am. Wood-Preservers' Assoc., 1942, pp. 435-447; Chem. Abs.,vol. 36, 1942, col. 6772.

The Disco process of low-temperature carbonization of coal produces a tar from which two types of wood preservatives can be made. One known as "Brown Solution" is an aqueous alkaline solution of certain high-boiling compounds mostly tar acids and the other a distillate from the tar called Disco creosote. Test blocks of yellow-pine sapwood were treated by pressure with various retentions of Disco creosote and "Brown Solution" and, for comparison, with high-temperature coal-tar creosote and chromated zinc chloride. The blocks were air seasoned for several months, then subjected to severe leaching, and finally exposed to standard wood-destroying fungi by the method of Waterman, and others, (Chem. Abs., vol. 32, col. 7695). Under the conditions of the test, the blocks treated with "Brown Solution" were the most resistant to decay. Disco creosote compared favorably with high-temperature creosote.

135. REID, W. T. [Low-Temperature Carbonization of Coal in Japan.] General Headquarters, Supreme Commander for the Allied Powers (Tokyo), Natural Resources Sec., Rept., No. 74, 1947, 87 pp.; Chem. Abs., vol. 42, 1948, col. 736.

Ten plants in Japan, Sakhalin, and Korea produced over 400,000 kiloliter of liquid fuel from 1940 to 1945. Coalite produced was used as fuel, for the manufacture of coke, and other purposes. The equipment, chiefly of German design (Lurgi and Koppers), was unsatisfactory for strongly coking coals. Plants and equipment are described, statistics are tabulated, and analyses of raw materials and products are given.

136. RHODES, E. O. German Low-Temperature Coal-Tar Industry. Bureau of Mines Inf. Circ. 7490, 1949, 84 pp.; Chem. Abs.,vol. 43, 1949, col. 3993.

Discusses briefly the carbonization processes by which low-temperature tar was produced, the quantities of tar made and their uses, processing methods, the recovery of phenols from the waste H_2O and light oils, and the manufacturing of chemicals from the phenols.

137. RIEDEL, H. G. [State of Scientific Knowledge and Technical Development in the Field of Tar Processing, Extraction, and Synthesis.] Bergbau u. Energiewirtsch, vol. 2, 1949, pp. 243-250; Chem. Abs.,vol. 46, 1952, col. 11639. Extensive bibliography.

A discussion of the working up of tars from low-temperature carbonization, their processing, extraction, and hydrogenation.

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138. RODRIGUEZ JURADO, J. [Low-Temperature Tar From Lignite From Puentes de Garcia Rodriguez (Coruña).] Combustibles (Zaragoza), vol. 10, 1950, pp. 83-92; Chem. Abs., vol. 46, 1952, col. 1229.

Low-temperature distillation of this lignite gives a tar comparable to that from German coal. This lignite has the following analysis: H_2O, 30 to 45 percent; volatile, 35 to 50 percent; fixed C, 30 to 40 percent; ash, 15 to 20 percent. Fischer analysis gives, in percent: Tar, 8 to 13; semicoke, 65 to 75; H_2O, 7 to 10; gas and losses, 12 to 15. Lignite in the form of briquets was distilled in an electric furnace up to a temperature of 550° with a temperature rise of 5° per minute while N was passed in at the rate of 40 liters per hour per kilogram. The gases were passed through gas oil, then through activated C. The yield of tar was 8.5 percent compared to the Fischer analysis of 9.86 percent. The tar yield (II) including the material recovered from gas oil and from the activated C (by steam) had the following properties: d_{20}, 0.906; congealing point, 26°; S, 1.4 percent; paraffin, 9.1 to 11.0 percent by various methods; 87 to 90 percent distilled at 80° to 400°. II was distilled through a 50-centimeter packed column, giving the following yields: To 210° (III), 14 to 16 percent; 210 to 250°, 9 to 10 percent; distilled at 50 millimeters, 60 to 65 percent; coke, 6 percent; gas and losses, 4 to 6 percent. III contained 12 percent phenols, 2 percent bases (as C_5H_5N), and 86 percent neutral oils (IV). IV had d_{20} 0.8340 and contained 2.87 percent S. A breakdown of S content gave, in percent: elementary S, none; mercaptans, 0.02 percent; disulfides, 0.11 percent; sulfides, 0.03 percent, inert, residual, or "thiophenic" S, 2.71 percent. A fractional distillation of IV showed the S concentrated in the lower boiling portions. IV contained 25 volume-percent olefins, 40 percent aromatics, and 35 percent paraffins plus naphthenes. Desulfurization of IV was tried unsuccessfully with silica gel, Al_2O_3, Na plumbite, HOCl, Cu oxide, and Cu. Anhydrous $AlCl_3$ was used in desulfurizing V (similar to IV but containing 2.25 percent S). At 25° and 4 hours, removal of S was linear with the amount of $AlCl_3$, 6 percent reducing S to 1.34 percent, with a gasoline yield of 75 percent. At temperatures above 50° the hydrocarbons were chlorinated. Increasing treating time above 1 hour had little effect. The large chemical requirement and losses make this method impractical. A number of experiments in desulfurization with H_2SO_4 indicated that the following conditions were optimum: Temperature, 0°; time for each treatment, 30 minutes; minimum H_2SO_4 concentration, 96 percent; quantity of acid (total) 15 to 18 weight-percent on gasoline, applied in 3 treatments with an intermediate and final redistillation. This reduces S to 0.3 percent with a gasoline yield of 70 to 75 percent of equal final boiling point with the charge, plus 10 percent higher boiling which can be blended with gas oil. Removal of 2.5 percent S as thiophene is equivalent to a loss of 10 percent in itself. In successive H_2SO_4 treatments removal of S is greater in the later steps. A desulfurized gasoline (VI) from this source had the following properties: 0.3 percent S; Cu corrosion, none; gum per 100 ml., 5 mg.; iodine number, 24.5; molecular weight, 120; percent olefins (calculated), 10; percent aromatics, 50 percent paraffins plus naphthenes, 40; distillation, 80° to 200°. Desulfurization with HCHO was effective, but with considerable losses. VI is too high boiling for use alone as motor gasoline, but can be blended.

Combustibles (Zaragoza), vol. 10, 1950, pp. 195-199.

The 210° to 250° fraction (VII) contained little wax (pour point below -15°), 10 to 15 percent phenols, and 2.0 to 2.8 percent S. This fraction, after refining, would probably be blended with higher boiling oil for Diesel fuel. The neutral oil (VIII) obtained by removal of phenols from VII was refined experimentally with SO_2, furfural, or H_2SO_4, respectively SO_2 was more selective than furfural in removing S and aromatics,

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but H_2SO_4 was best - a treatment with 15 percent H_2SO_4 of 95-percent concentration gave a 65-percent yield of raffinate of density 0.8560 and 1 percent S. VIII had density 0.8865 and 2.7 percent S. The results of experiments with SO_2 and furfural are shown on graphs similar to those of Hunter and Nash. The phenols (IX) from VII are not particularly useful, not being suitable for condensation with HCHO. Analysis of IX showed d_{15} 1.041, 0.462 percent S, 99.5 percent phenols, distilling at 191° to 228°. Reaction of IX with $POCl_3$ gave a 90 percent yield of phosphate ester, for which the analysis is given.

Combustibles (Zaragoza), vol. 10, 1950, pp. 279-291.

Bases separated from the various fractions of this tar by extraction with 30 percent H_2SO_4 amount to 0.5 to 0.6 percent of the total tar. In an Engler distillation only 10 to 12 percent boil below 140°. Neither the quantity nor the nature of these bases is such that their isolation or treatment would be of interest. The 250° to 260° fraction (I) from vacuum distillation of the tar contains considerable paraffin. Distillation of the tar, when continued to coke, gives a 60 to 65 percent yield of paraffin distillate (II). Three samples of II, from separate shipments of lignite, had the following properties: d_{50}, 0.91 to 0.93; paraffin separated with $(CH_3)_2CO$ at -20°, 19 to 23.5 percent; same at 0°, 16 to 18 percent; S, 1.5 to 2 percent; creosotes, 10 to 12 percent. II cooled to room temperature crystallizes paraffin in large scales, giving a solid mass from which part of the oil separates easily. II is a source of soft and hard paraffin, oil suitable for Diesel fuel, ordinary fuel oil, and creosotes, but does not give lubricating oils. Hydrogenation of II to give lubricating oil, as suggested by others, has never been successful industrially. Substitution of extraction of tar for distillation for recovery of paraffin, as has been suggested, is not feasible, because distillation is necessary to eliminate substances that tend to prevent crystallization. In the distillation of tar some cracking is desirable to give II from which paraffin crystallizes readily. In this case, as contrasted with petroleum refining, paraffin is a prime product. For this reason industrial distillation of this tar is carried to coke, since the residual pitch thus gives a good yield of paraffin and high-molecular-weight liquids for use in Diesel fuel. The residue (III) from II after removal of paraffin is not treated successfully by the classic acid-alkaline treatment. The neutral oil (IV) after "dephenolization" is quite reactive to even relatively dilute H_2SO_4 even at low temperatures, giving large losses in acid treatment. Extraction of III with 10 percent NaOH, and acidification of the extract with acid, even CO_2, give a very viscous product. For these reasons solvent extraction of II was tried in order to effect (a) removal of paraffin, (b) extraction of oxygenated compounds, and (c) separation of residual oil into suitable fractions. A large quantity of II (6.7 kg.) was cooled to 20° and paraffin filtered out on a press, this amounting to 5 percent of the original tar, leaving an oil (V) more suitable for solvent extraction. Results of selective extraction of phenols from synthetic mixtures and from V are given, with the MeOH (100, 90, and 80 percent); EtOH (100, 90, and 80 percent); a mixture of MeOH 70, $(CH_3)_2CO$ 10, and H_2O 20 percent; and furfural as solvents. Furfural was more effective as a refining solvent than the anhydrous alcohols, but 80 percent MeOH was more selective for phenols, giving an extract containing 40 percent creosote (solvent-free basis). It was concluded that best results would be given by exhaustive extraction with 80 percent MeOH (3 washes at 1:1 volume) followed by furfural extraction at 20°. A 1.5-kilogram portion of V was treated thus, giving 815 grams of raffinate from which additional paraffin separated, amounting to about 2 percent of the original tar, leaving neutral oil (VI). Dewaxing of oils with solvents is discussed at length. Analytical results, as melting point of paraffin and freezing point of dewaxed

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oil, are given for treatments of VI by $(CH_3)_2CO$, $(C_2H_5)_2O$-EtOH 50:50, C_6H_6-$(CH_3)_2CO$ at 4 compositions from 50:50 to 30:70, and MeOH-C_2HCl_3 at 3 compositions from 60:40 to 50:50. MeOH-C_2HCl_3 at 60:40 gave the best melting point of paraffin except for $(CH_3)_2CO$ alone, which has certain disadvantages in large-scale operation. The MeOH-C_2HCl_3 60:40 mixture was used to dewax a substantial quantity of VI with 7 to 10 volumes of solvent per volume of VI. In purification of pressed wax 14 volumes per volume was used (10 to dissolve and 4 for washing). The properties of various paraffin fractions are given. Melting point was 42° to 45° for paraffin from dewaxing VI, 50° to 52° for the fraction separated from VI at 20° after solvent extraction, and 55° to 57° for the fraction separated from V on cooling to 90°. These paraffins are quite reactive with H_2SO_4 at concentrations above 85 percent. The dewaxed oil was blended with the chemically treated 210° to 250° fraction from distillation and the small quantity of residue from the rectification of light distillate to give a Diesel fuel having the following properties: d_{15} 0.8512; viscosity at 20°, 5 centistokes = 1.4° Engler (E.); average boiling point 282°; flash point, 80°; S, 1.2 percent; Conradson C, 0.2 percent; pour point, -15°; Br number, 12; cetane number (calculated from density and boiling point), 50. The extract (creosotes) had the following properties: d_{20}, 1.0086; viscosity at 50°, 6.5° E.; S, 3.5 percent; pour point, 8°. An attempt to produce lubricating oil from this tar gave a 6 percent yield of oil of d_{15}, 0.9475; viscosity index, -78; iodine number 35. A flowsheet of the entire treatment of tar is given, with yields as follows from 1,000 kilograms of tar in kilogram: Tricresyl phosphate, 25; gasoline, 100; gas oil, 350: creosote oil, 105; fuel oil (Diesel), 150; soft paraffin, 50; hard paraffin, 70; coke, 70.

139. RODRIGUEZ JURADO, J. [Synthetic Lubricating Oils.] Combustibles (Zaragoza), vol. 13, 1953, pp. 167-175; Chem. Abs., vol. 48, 1954, col. 4821.

A yellow solid petroleum paraffin d^{60} 0.808, I number 3.4, average molecular weight 350, chlorinated and condensed with benzene, xylene, or naphthalene by the Friedel and Crafts reaction, in the presence of anhydrous $AlCl_3$ or activated Al, gave synthetic lubricating oils. Xylene was the preferred aromatic compound, naphthalene required the use of less completely chlorinated paraffin, benzene produced resins difficult to remove and gave darker oils with excessive green fluorescence. Activated Al rather than anhydrous $AlCl_3$ gave darker oils with higher viscosity and Conradson C values. Tar from the low-temperature distillation of lignite, used as a source of a paraffin fraction melting 40° to 48° (chlorinated to 26.5 percent Cl) and an aromatic fraction, 45 percent aromatic compounds by volume (mainly polysubstituted benzenes), I number 10, was converted to a similar synthetic lubricant with the following properties: Kinematic viscosity at 210° F., 50.4 centistokes; viscosity index, 92; Conradson C, 1.5 percent; solidification point, 9°; S, 0.41 percent.

140. ROGA, B., AND IHNATOWICZ, M. [Characteristics of Primary Tars From Certain Polish Bituminous and Brown Coals.] Prace Glownego Inst., Ser. B, Górnictwa, Komun., vol. 161, 1954, 16 pp.; Chem. Abs., vol. 50, 1956, col. 10379.

Properties of primary tars obtained in Lurgi-Kulczyński tunnel ovens (I) and in Lurgi shaft ovens (II) are evaluated. The primary tars were distilled in 50-kilogram batches. Specific gravity of primary tars and oils obtained from bituminous coal was 0.990 to 1.057 and from brown coal was 0.936 to 1.005. The insoluble part of these tars and oils in benzene was 0.04 to 0.75 percent; the content of acidic compounds was 23 to 58 percent by volume. The primary tars obtained from bituminous coal contained 0.8 to 2.7 percent of paraffin wax and from brown coal 2.0 to 14.4 percent. The yield of gasoline fractions boiling below 200° was from primary tars from bituminous coal obtained in I 8.4 to 10.6 percent and in II 3.1 to 4.7 percent;

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primary tars from brown coals obtained from I contained 5.8 to 6.3 percent and from II 2.7 percent of such gasoline. The yield of phenols and cresols did not depend on the method of distillation. Primary tar obtained from II gave residue 39 to 51 percent while from I 30 to 42 percent (softening point of the residue was 70°).

ROMOVÁČEK, J. See abs. 104, 106.

ROMOVÁČKOVÁ, H. See abs. 104, 106.

141. ROSENDAHL, F. [Importance of Low-Temperature Distillation of Coal for German Fuel Economics.] Teer u. Bitumen, vol. 40, 1942, pp. 167-171; Chem. Zentr., vol. 11, 1942, p. 2225; Chem. Abs., vol. 38, 1944, col. 3109.

Improved processes are available to give low-temperature distillation products economic importance. Low-temperature distillation is limited to the utilization of high-volatile nut coals and briquets. The coke formed can be used as a smokeless fuel, and the tar directly as a fuel oil. Phenols can be extracted, in order to work up the residue into fuel oil and motor fuel. Large deposits of coal in Upper Silesia and in the Saar District are suitable for low-temperature distillation.

ROY, A. K. See abs. 7.

RUPPERT, W. See abs. 156.

142. SABATIER, J. L. [Treatment of Tar From Low-Temperature Carbonization.] Ann. mines Belg., 1957, pp. 167-170; Chem. Abs., vol. 51, 1957, col. 17142.

Tar from the low-temperature carbonization process has a more aliphatic character and a greater phenolic content than does tar from high-temperature coking ovens. Distillation of the crude tar produced at Marienau gives the following yields; light-oil boiling point less than 185° 1, phenolic oil A boiling point 185° to 230° 20, phenolic-oil B boiling point 230° to 270° 8, denaphthanating-oil boiling point 270° to 320° 5, heavy-oil boiling point 320° to 400° 32, and pitch 70 KS 31 percent. The pitch is miscible with petroleum pitch and is intermediate in properties between petroleum pitch and coal-tar pitch from the high-temperature coking process.

SALIMGAREEVA, F. G. See abs. 69, 71, 72, 73, 123, 124.

SAMOĬLOV, S. M. See abs. 126.

SASSE, E. See abs. 155.

143. SCHICK, F. [Working Up of Low-Temperature Tars by Means of Solvents.] Reichsamt Wirtschaftsausbau, vol. 37, 1941, pp. 27-39; Chem. Abs., vol. 41, 1947, col. 6387.

A discussion of the theoretical and engineering aspects.

SCHONGUT, S. See abs. 163.

144. SCHMITT, A. [Composition and Working Up of Low-Temperature Tars.] Reichsamt Wirtschaftsausbau, vol. 37, 1941, pp. 17-25; Chem. Abs., vol. 41, 1947, col. 6387.

The chemical constituents of the gasoline fraction, the fuel-oil fraction, and the lubricating-oil fraction (Fischer and Gluud's subdivision of coal tars) are described. Methods of working up the tar are distillation, cold treatment by means of solvents, direct conversion into heating oil, and hydrogenation.

SHAFIR, G. A. See abs. 19.

145. SHIOTSUKI, Y. [Low-Temperature Carbonization Plant for Lignite.] Jour. Fuel Soc. Japan, vol. 28, 1949, pp. 114-118; Chem. Abs., vol. 46, 1952, col. 2265.

The design and operational data of a low-temperature carbonization plant for Japanese lignite are described. The retort had a vertical cylinder with a capacity of about 10 tons per day. By continuous operation, in which a part of the gas produced was circulated and

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burned in the lignite zone, about 40 percent semicoke and 3 to 4 percent tar were obtained. From the tar the following products were separated: Low-temperature carbonization cresol, 18.3; motor fuel, 1.00; solvent, 9.97; cresol for medical uses, 11.85; and creosote oil, 32 percent.

SHOROKHOVA, M. V. See abs. 70, 123, 124, 125, 126.

SIXT, K. See abs. 147.

SMITH, H. B. See abs. 112.

146. SMOKELESS AIR. Low-Temperature Carbonization. Vol. 76, 1950, pp. 74-78; Fuel Abs., vol. 9, 1951, abs. 1597.

The "Coalite" process for low-temperature carbonization of coal is described. This has as its object the production of the smokeless fuel "Coalite," which contains approximately 83 percent, carbon; 10 percent, volatile matter; and 7 percent ash. The process uses best washed and graded coal and this is carbonized in retorts designed to produce the maximum quantity of large-sized pieces and insure that coal oils recovered are low in ash and free carbon. Retorts are heated by radiation only to avoid exceeding the carbonizing temperature of 600° C. The byproducts obtained are discussed; with this process the quantity of phenols and cresols obtained is more than is obtained with ordinary high-temperature carbonization, and other derivatives now marketed are petrol, diesel oil, Lotemsol and Florastic (a material used for working into coloured mastic floorings).

147. SPENCER, A. M., JACOBSON, A., AND SIXT, K. Liberation and Treatment of Fiber From Cotton Stalks. U. S. Patent 2,668,110 Feb. 2, 1954. Chem. Abs., vol. 48, 1954, col. 6123.

Cotton stalks are softened by using wetting agents (0.1 to 5 percent fatty derivative) in water containing 0 to 3 percent NaOH or Na_2CO_3 at atmospheric pressure. The stock is then deaerated in a vacuum tank and then pumped through a special digester at 25 to 150 pounds per square inch and 250° to 350° F. The suspension of softened fiber bundles is then defibered in a rapidly rotating beater with rubber whips. The apparatus is described. This pulp is treated with a water-resistant, organic emulsion by thorough mixing with either a suspension of 50 penetration asphalt, 70 percent chlorinated wax, or low-temperature coal tar. The emulsion is then broken with a suitable coagulating agent.

148. SPENCER, W. D. Science of Coal-to-Oil Conversion. Petroleum (London), vols. 7, 39, 1944, pp. 34-39; Chem. Abs., vol. 40, 1946, col. 3867.

A general review is given of the principles of the most important commercial processes for obtaining oil from coal, and of the yields obtained by, and special features of each process. The composition of typical tars obtained by the low-temperature carbonization of coal, yields of products other than tar, estimated costs of running a plant of 700 tons daily capacity and annual British statistics on the industry from 1930 through 1938 are tabulated. The text is chiefly concerned with the various types of retorts, which have been developed for use in this process. Economics and cost of production are discussed.

149. STRANKMULLER, J. [Low-Temperature Carbonization.] Bergbautechnik, vol. 4, 1954, pp. 483-488; Fuel Abs., vol. 18, 1955, abs. 1203.

The low-temperature carbonization plant at Böhlen in Eastern Germany (the first in which Lurgi type ovens were installed) worked with a throughput of 300 tons of brown-coal briquets per day per oven since 1936, later increased to 365 tons per day. The rising demand for low-temperature tar for hydrogenation purposes led to development of a modified oven of 450 tons throughput. This was achieved by stepping up the flow of the circulating gas and air mixture from 420,000 to 560,000 cubic feet per

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hour and by additional rows of V-shaped deflectors across the width of the oven chamber, which break up and loosen the charge, thus reducing cooling-gas pressure and allowing a greater flow of scavenging gas. The distance traversed by each briquet is nearly doubled, and the temperature gradient is less. It is claimed that the tar and the coke from modified ovens are of comparable quality. The compressive strength of the briquets was found to have an appreciable effect on the output. Better quality briquets would lead to longer life of oven linings.

150. SUBRAHMANYAN, S., AND NAIR, A. P. [Low-Temperature Tar Obtained From South Arcot Lignite.] Jour. Madras Univ., vol. 24B, 1954, pp. 393-403; Chem. Abs., vol. 50, 1956, col. 5275.

Distillation of South Arcot lignite yielded a tar having the following composition: Specific gravity 0.931; melting point 31.5°; volatiles 36.5, fixed C 1.25, ash 0.34, H_2O 10, free C 2.6, carbenes 1.6 percent; solubility 97.4 percent in C_7H_8, 99.35 percent in CS_2, 97.8 percent in CCl_4, 95.2 percent in petroleum naphtha. Fractional distillation gave fractions up to the 320° end-point. Extraction of these fractions with 10 percent NaOH gave 19.3 percent tar acids, whose boiling range was 197° to 240°. Products recovered from the tar distillate and the tar acids included naphthalene, pyridine bases, benzene and naphthas, creosote oil, paraffin wax, phenols, and pitch.

SUGA, S. See abs. 33, 34.

151. SUGIURA, S., UENO, H., AND YOKOYAMA, H. [Tar Bases in Low-Temperature Coal Tar.] Coal Tar (Kooru Taaru) vol. 3, 1951, pp. 292-298; Chem. Abs., vol. 46, 1952, col. 3734.

Tar bases were extracted from three fractions, that boil below 260°, at 260° to 280°, and 280° to 330°, respectively, of the low-temperature tar obtained by the carbonization of Ube coal in a Koppers' vertical retort at approximately 750°. These were divided, respectively, into three groups, acetate-forming amine, HCl salt-forming bases (I), and $CHCl_3$-soluble bases (II), and further fractionally distilled. From the physical and chemical properties of the fractions thus obtained, it was concluded that low-temperature coal tar contained no low boiling pyridine homologues and that beside higher homologues of pyridine, nonaromatic, more saturated, and less basic compounds of larger atomic weight and smaller refractive index, such as derivatives of pyrrole and indole also existed as in crude petroleum.

152. SUGIYAMA, S., AND NAGASAKA, K. [Graphitizing Property of Coal Tar With Aluminum Chloride.] Jour. Chem. Soc. Japan, vol. 56, 1953, pp. 656-658; Chem. Abs., vol. 48, 1954, col. 12394.

Aluminum chloride (5 percent) was added to two kinds of low-temperature tar, which was carbonized at 600°. The produced coke was then graphitized at various temperatures up to 2,900°. The electron micrographs, crystallite dimensions by X-ray diffraction, and wet-oxidation index of each graphitized sample were given. The wet-oxidation degree of the sample graphitized at 1,860° was remarkably high, and hence it was suggested that there exists an intermediate structure of carbonaceous material between two-dimensional carbon black-like structure and three-dimensional graphite.

153. SUZUKI, A., KITAHARA, A., AND KOGA, M. [Utilization of Low-Temperature Tar.] Jour. Chem. Soc. Japan, vol. 54, 1951, pp. 789-790; Chem. Abs., vol. 47, 1953, col. 7760.

Thermal cracking of tar fractions by a continuous pilot plant similar to that of petroleum has been carried out with the view to get solvent naphtha fractions from the less useful paraffin-containing oil and the middle oil from which tar acid was eliminated, and to get phenol and cresol fractions from tar acids of high boiling point. The data of working conditions are presented.

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Jour. Chem. Soc. Japan, vol. 54, 1951, pp. 28-29.

It was found that the peculiar disagreeable odor adherent to phenol and cresol was removed by subjecting tar acids and the middle oils containing tar acids to thermal cracking at 450° to 520° in a continuous pilot plant. The deodorization was, by analysis, confirmed to be due to removing thio-tar acid by thermal decomposition.

SZKIBIK, C. See abs. 11.

TAKESHITA, K. See abs. 76, 77.

TAKIZAWA, M. See abs. 55.

TERAJIMA, N. See abs. 76.

TERASHIMA, N. See abs. 78.

154. TERRES, E. [Decomposition of Low-Temperature Carbonization Tars From Lignite and Oil Shale With Selective Solvents.] Festschr. Paul Schläpfer, 1950, pp. 161-171; Chem. Abs., vol. 46, 1952, col. 721.

Phase diagrams for the liquid SO_2 extraction of these tars are given, as well as flowsheets for the end products of their total decomposition by various solvents.

155. TERRES, E., FISCHER, K., AND SASSE, E. [Composition of Solid Paraffins From Mineral Oils and Low-Temperature Tars (Brown Coal).] Brennstoff-Chem., vol. 31, 1950, pp. 193-207; Brennstoff-Chem., vol. 30, 1949, p. 440; Chem. Abs., vol. 44, 1950, col. 9142.

The paraffin fraction of oils and tars is generally considered to have a very complex nature, containing many thousands of compounds. Methods were worked out for separating such mixtures into their individual compounds, by using fractional crystallization from selective solvents. This method of separation was first successfully applied to a homogeneous paraffin from the low-temperature distillation of brown coal tar. The results of this separation with selective solvents are given for the cake and soft paraffins as well as for the heavy Diesel-oil fraction. The brown-coal paraffin consists of straight-chain paraffins and the homologues of one isoparaffin type, while the heavy Diesel-oil fraction consisted of different isoparaffins, principally with molecules from C_{19} to C_{22}. Experiments relative to the effect of distillation on splitting the isoparaffin homologues of the solid paraffins and their conversion into normal paraffins of lower molecular weight as well as into lower isoparaffins of the same structure indicated that these isoparaffins are 1-sided branched paraffins and that the distillation causes splitting in the straight part of the paraffin chain. This separation method was also applied to the solid paraffin from mineral oil. Paraffins were isolated from four successive libricating-oil fractions from the same crude oil. These paraffins have a more complicated structure; in addition to straight-chain paraffins they contain the homologues of a whole series of isoparaffins. A quantitative separation was made of the oil fractions; the molecular weight of the isolated compounds varied from 250 to 650 and increased with increasing boiling point of the mineral oil from which the paraffin was recovered. Of the very large number of possible compounds only 75 were isolated - it is estimated that the total number of compounds in the oil does not exceed one thousand. It is also of interest that the isoparaffins found in brown coal tar and in shale oil are among those found in mineral oil. The structure of the isoparaffins separated in this investigation has not yet been determined.

156. TERRES, E., GEBERT, F., HÜLSEMANN, H., PETEREIT, H., TOEPSCH, H., AND RUPPERT, W. [Chromatographic Separation of Low-Temperature Tar.] Brennstoff-Chem., vol. 36, 1955, pp. 67-78; B.C.U.R.A., vol. 19, 1955, abs. 1048; Chem. Abs., vol. 50, 1956, col. 8175.

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A theoretical study of the various chromatographic separation processes is presented.

Part II. Brennstoff-Chem., vol. 36, 1955, pp. 162-169.

Chromatographic methods and apparatus are discussed. The Folin-Denis reagent (Na tungstate molybdate in H_3PO_4) is used for developing paper chromatograms of phenol mixtures. Other reagents are given.

Part III. Brennstoff-Chem., vol. 36, 1955, pp. 228-236.

Experiments with crude phenolic mixtures in benzene-MeOH over an alumina chromatographic column are reported. The most effective separation into crude fractions was obtained from a petroleum-ether solution with benzene and benzene-MeOH elution. These fractions are analyzed by paper chromatography. R_f values for 29 phenols and benzoic acid from water-saturated AmOH are given. Folin-Denis reagent and ultraviolet absorption is used for identification of the phenolic compounds. R_f values for monohydroxy compounds are larger than 0.9, dihydroxy 0.80 to 0.9, trihydroxy 0.6, hydroxytoluic acids 0.39 to 0.56. R_f values of Na and K salts are different from those of the free phenols. Tests in aqueous solution near 0° gave important results. R_f values of the less polar materials decrease and less material is lost through evaporation, smaller and sharper spots are obtained and liquids move at a more even rate. A series of isomeric alkyl phenols is reported; ortho alkyl groups decrease the migration rate most effectively.

Part IV. Brennstoff-Chem., vol. 36, 1955, pp. 272-274.

Vapor-pressure curves of 39 phenolic materials likely to occur in tars are determined.

Part V. Brennstoff-Chem., vol. 36, 1955, pp. 275-280.

Two successive vacuum fractionations and subsequent paper chromatography separated most phenolic components of the tar used.

157. THAU, A. [Fuel Oil From Low-Temperature Carbonization of Coal.] Teer u. Bitumen, vol. 39, 1941, pp. 191-193, 199-201; Chem. Abs.,vol. 36, 1942, col. 5974.

A review of German developments during the last 20 years. Four methods for the low-temperature carbonization of coal have been developed to the industrial stage, two involving the use of externally heated, intermittent, metallic chamber ovens and two employing the principle of internal heating by means of a current of gas. Tar from externally heated retorts can be used directly as fuel oil, but that from internally heated retorts requires further treatment. In order to extend the range of coals available for low-temperature carbonization, and to economize metals, an externally heated type of retort constructed of ceramic material has been developed to the industrial stage by T. An excellent coke and a tar that can be used directly as fuel oil are obtained. The properties of the tar obtained from Upper Silesian coal are briefly summarized.

158. _____. [Low-Temperature Carbonization of Bituminous Coal for the Production of Solid, Liquid, and Gaseous Fuels.] Brennstoff-u. Warmewirt, vol. 24, 1942, pp. 7-12, 26-29, 40; Gas-u. Wasserfach, vol. 85 n 35/36, Aug. 29, 1942, pp. 408-409; Chem. Zentr.,vol. I, 1942, p. 2613; Chem. Abs.,vol. 37, 1943, col. 3245.

Properties and uses of low-temperature coke for producing ferrosilicon, CaC_2 generator gas and water gas, as a fuel for boilers and household use and as a diluent for coking coal, and the properties and uses of low-temperature tar, gasoline, gas, and liquefied gas are described. By using a circulating gas, it is possible to obtain in low-temperature

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carbonization of bituminous coal a fuel oil for the navy. Aging-test data of such an oil are given. Several plants in Upper Silesia, using the Lurgi circulation process are producing a fuel oil that meets specification.

159. _____. [Processing of Tar From the Low-Temperature Carbonization of Bituminous Coal for the Manufacture of Fuel Oil.] Teer u. Bitumen, vol. 41, 1943, pp. 114-119; Chem. Zentr., vol. II, 1943, p. 1430, Chem. Abs., vol. 38, 1944, col. 5064.

Various processes for the conversion of tar to good fuel oil are described and specifications for fuel oil are given. T. refers to the possibility of fractionally condensing the carbonization vapors according to the Feld process.

TOEPSCH, H. See abs. 156.

TOLUBINSKIĬ, V. I. See abs. 19.

TRILLING, C. A. See abs. 112.

160. TSUKHANOVA, O. A., AND MIRINGOF, N. S. [Influence of Thermal Conditions on Process of Separating Out Products of Low-Temperature Carbonization.] Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, vol. 8, 1949, p. 1187; title in D.S.I.R. Trans. Contents Lists Russian Periodicals, vol. 7, December 1949, p. 21; Fuel Abs., vol. 7, 1950, abs. 2916.

TUMBUSOVA, Z. P. See abs. 72.

161. TURSKIĬ, Y. I. [Effect of the Rate of Heating on the Quality of the Primary Tar in Low-Temperature Coal-Carbonization Process.] Khim. i Tekhnol. Topliva, No. 3, 1956, pp. 59-70; Chem. Abs., vol. 51, 1957, col. 18553.

Two stages are observed. The first stage yields products of the primary and partial decomposition of coal, mainly water, CO_2, and CO as decomposition products of functional groups (—COOH, >CO, —OH, and so forth). No tar is formed in this stage. The structural decomposition and tar formation occur in the second stage. The rate of heating is important for the quality of the tar obtained. The slow rate of heating with both stages following each other yields a good-quality tar, richer in C and H, with lower O content. In case of high rate of heating both stages overlap. The tar is of poorer quality with higher specific gravity, and contains more O and asphaltenes. The complete experimental data are given in detail.

UEDA, H. See abs. 97.

162. UEMURA, Y., AND HATTORI, S. [Resin From Low-Temperature Coal Tar.] Japanese Patent 180,127, 1949; Chem. Abs., vol. 46, 1952, col. 1234.

Low-temperature coal tar is heated with acid clay, filtered; the filtrate is mixed with HCHO and $PhNH_2$, heated at 100°, then to 120° to 130° to separate into 2 layers, and the lower layer is taken.

UENO, H. See abs. 151.

163. VYBIHAL, J., AND SCHONGUT, S. [Aromatization of Gasolines and Production of Aromatic Hydrocarbons.] Chem. prumysl (Chem. Ind. Prague), vol. 6, 1956, pp. 133-137; Chem. Abs., vol. 50, 1956, col. 17399.

Gasolines and other narrow fractions obtained by high-pressure catalytic hydrogenation of tars from low-temperature carbonization of North Bohemia brown coals are suitable materials for aromatization processes. Platinum and molybdenum catalysts were studied, and platinum was especially effective. Benzene, toluene, different xylenes, and ethylbenzene were obtained as reaction products.

164. WALTHER, H. [Microstructure and Properties of Lignite Tar and Pitch.] Chem. Tech. (Berlin), vol. 6, 1954, pp. 91-97; Chem. Abs., vol. 48, 1954, col. 11031.

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Photomicrographs reveal the presence of crystalline wax, which affects the working properties in lignite tars and pitch. The crystals are large needles after slow cooling and small after rapid cooling. The crystals are paraffinic in character. All samples were nonhomogeneous. Thus the properties of lignite tar and pitch are varied by the source of the lignite and history of the specimen, neither softening point nor dropping point seems to satisfactorily characterize these tars. The samples exhibit thixotropic behavior characteristic of a structural viscosity and show hysteresis loops on varying the working rate. The variations have hindered use of lignite tars and pitches except where solubility in a solvent such as coal tar oil can be used to advantage.

Part II. Chem. Tech. (Berlin), vol. 7, 1955, pp. 471-472; Chem. Abs., vol. 50, 1956, col. 14209.

Viscosimetric and microscopic investigations indicate unfavorable deformation properties of brown-coal tars. These properties, the tendency of paraffinic portions to crystallize, can be inhibited or entirely suppressed when small quantities of montan wax (2 to 5 percent) are added. The rheological properties of brown-coal tar then resemble those of anthracite tars.

165. WATSON, G. H., AND WILLIAMS, A. F. [Tar Obtained From Fluidized Bed Carbonization.] Ann. mines Belg., 1957, pp. 154-167; Chem. Abs., vol. 51, 1957, col. 17142.

Tar produced by carbonization, at 650°, of a bed of coal fluidized by steam was studied. A 42 percent volatile coal was used. It yielded 110 liters of tar, not including an appreciable loss, and 390 liters of aqueous fluid per ton of coal treated. The latter came principally from the fluidizing steam. The tar density was about 1.09 grams per cubic centimeter, and an Engler distillation gave 2.2 percent distilled up to 210°, 3.9 percent at 210° to 230°, 10.7 percent at 230° to 270°, 17.9 percent at 270° to 300°, 21.4 percent above 300°, 35.2 percent coke, and 8.7 percent loss. The tar was extracted with C_6H_6, and the extract was treated to determine acids, bases, and neutral oil. The results were: Entrained C 11.2, insolubles 12.0, acids extracted with $NaHCO_3$ 2.2, acids extracted with NaOH 15.4, bases 2.7, neutral oil 40.4, tarry residue 10.8, and operating loss 5.3 percent. The yield of phenols was high, most of them with elevated boiling points. The neutral oil consisted primarily of aromatic compounds, many of which contain O. Most of the neutral oil also had a high-boiling point. The phenols were further studied by conventional methods and the neutral oils by solvent extraction and chromatography.

166. WEIZMANN, C. Improvements in and Relating to the Utilization of Coal Oil. British Patent 574,963, May 13, 1940; B.C.U.R.A., vol. 10, 1946, abs. 1206.

A fraction of low-temperature tar boiling between 100° and 180° C. from which the acidic and basic constituents have been removed is aromatized in the vapor phase in the presence of a hydrogenation-dehydrogenation catalyst at 600° to 700° C. preferably at atmospheric pressure.

167. WILLIAMS, A. F. Recovery of Catechol From Low-Temperature Tar. Chem. and Ind., 1955, p. 148; Chem. Abs., vol. 49, 1955, col. 7225.

In the low-temperature carbonization of coal, catechol (I) is usually recovered from the aqueous liquor. Williams reports the recovery of I from the low-temperature tar in a quantity equal to that obtained from the liquor by treating a C_6H_6 solution of 1,936 grams undistilled tar with five 9.6-liter portions of saturated $NaHCO_3$ solution. The 43 grams of crude acids recovered was fractionated through an 8-plate column at 5 millimeter. The distillates, boiling 220° to 250°, which precipitated solids at room temperature were

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crystallized from C_6H_6 to yield 13 grams white, platelike crystals of I. I was identified by mixed melting point, preparation of picrate, and X-ray examination. In earlier work, Morgan, and others (Chem. Abs., vol. 23, col. 3326) observed only a trace of I in a low-temperature tar distillate.

WILLIAMS, A. F. See abs. 165.

168. WOLFSON, M. L., PELIPETZ, M. G., CLARK, E. L., AND GORIN, E. Low-Temperature Tar. Chem. Eng. News, vol. 31, 1953, p. 1861; Fuel Abs., vol. 14, 1953, abs. 4356.

In the normal high-temperature coking of coal, much of the tar is cracked to gaseous hydrocarbons, while low-temperature carbonization yields comparatively large quantities of tar. The possibilities of increasing the output of this product by uncatalyzed hydrogenation have been studied by the Federal Bureau of Mines. It was found that when only 50 percent of the tar is converted to light oil and gas, relatively little hydrogen is required. About 5 percent of the products consists of C_6 to C_8 tar acids and aromatics. Much of the naphthenic materials in this range may be converted to aromatic chemicals by reforming.

YAMADA, F. See abs. 85, 86, 88.

YAMAMOTO, S. See abs. 3.

YOKOGAWA, C. See abs. 33, 34.

YOKOYAMA, H. See abs. 151.

169. YOSHIDA, T. [Dehydration of Hydrated Low-Temperature Tar.] Bull. Nagoya Inst. Technol., vol. 1, 1949, pp. 183-184; Jour. Fuel Soc. Japan, vol. 30, 1951 (English), pp. 82-88; Chem. Abs., vol. 44, 1950, col. 8624.

Yoshida examined the mechanism of the dehydration of hydrated low-temperature tar with a microscope. The tar containing free carbon and coal dust is so stable that the removal of the above substances and water by a physical method is very difficult. Addition of light oil produced by fractionation of low-temperature tar facilitates the operations. Yoshida tried using the separate acid, neutral, and basic components of the light oil; the acid oil proved to be most effective. For many reasons it is convenient to use light oil as it is. In this method the quantity of light oil required is 2 to 3 times that of tar. But in supplementing the centrifugal method, the quantity of light oil needed might be only half the amount of tar.

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